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PC MAGAZINE

FIRST LOOKS

First 386SL Laptop! Zenith's Pricey MastersPort Promises Longer Battery Life

EXCLUSIVE!

COMPUTERS

Bang for the Buck: PC Mag's New Tool Separates the Deals From the Dogs

CONNECTIVITY

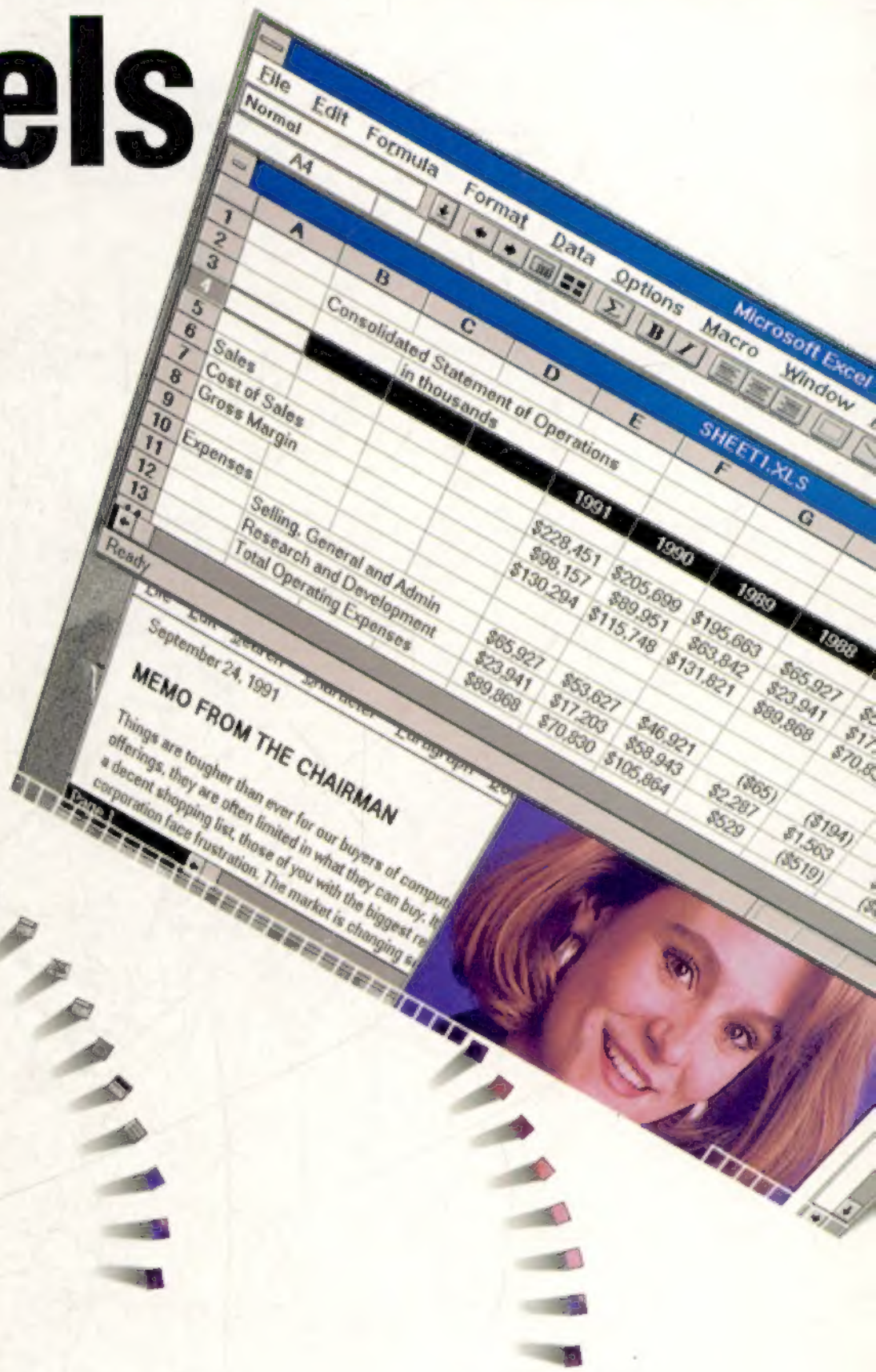
13 Low-Cost LANs Beat NetWare on Price—but How Close On Performance?

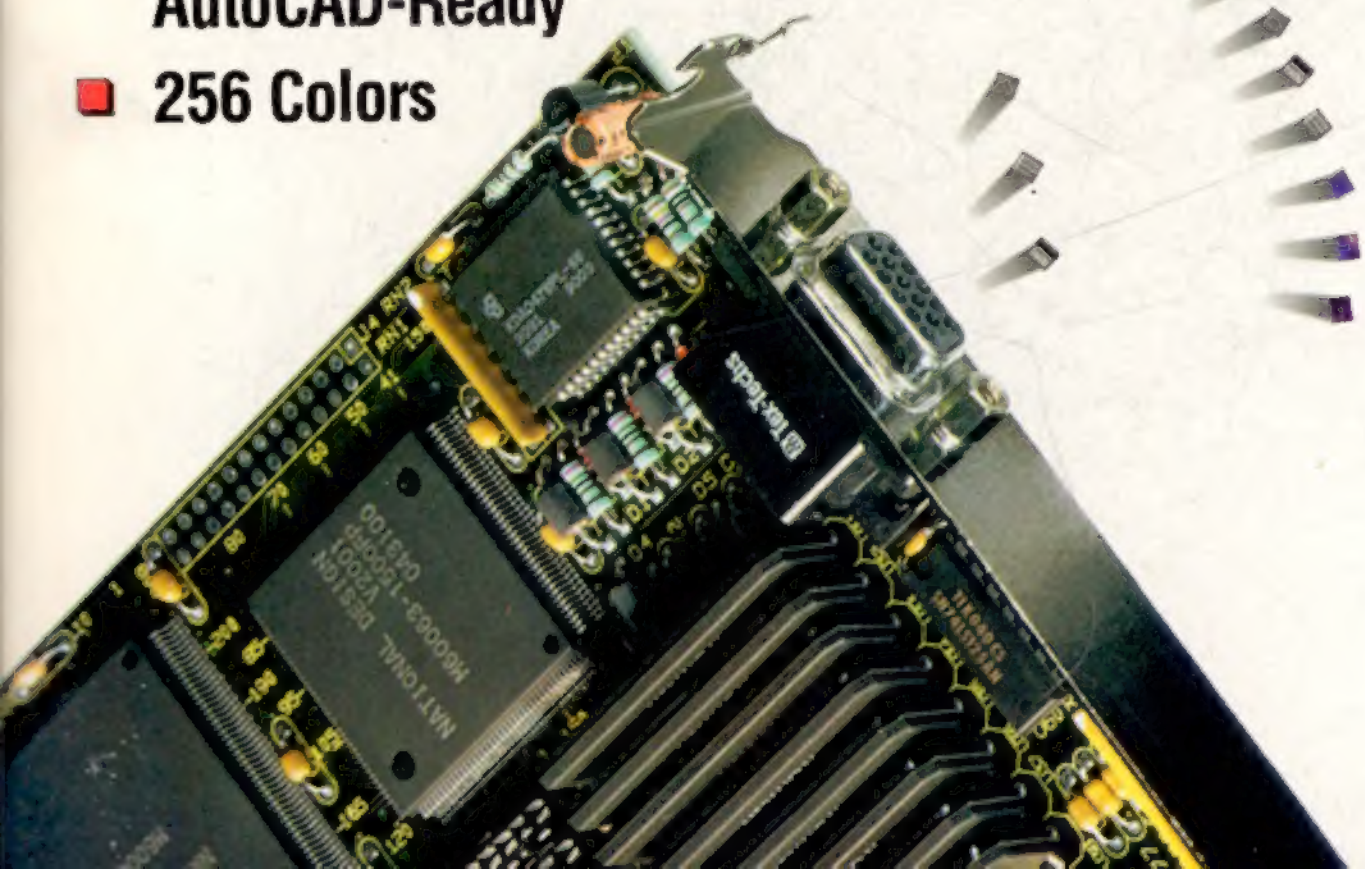
JUNE 25, 1991 THE INDEPENDENT GUIDE TO PERSONAL COMPUTING VOLUME 10 NUMBER 12

786,000 Pixels Can't Be Wrong!

PC Labs Tests 15 High-Speed High-Res Video Cards

- 1,024 x 768 Resolution
- Windows- and AutoCAD-Ready
- 256 Colors





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It took us thousands of steps to make this spreadsheet do what we wanted.

Pro Forma In

1991

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1,466,437

184,845

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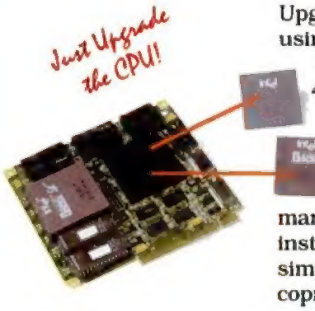

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intel inside

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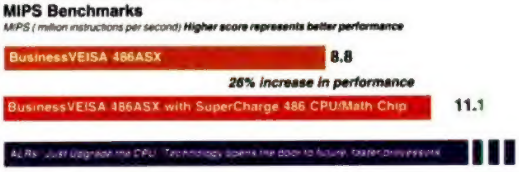
MIPS Benchmarks

*MIPS (million instructions per second) **Higher score represents better performance***



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CPU	20-MHz i486SX	20-MHz i486SX	20-MHz i486SX	20-MHz i486SX
Bus Architecture	**ISA**	**EISA**	**EISA**	**Micro Channel**
RAM Standard	1-MB	1-MB	1-MB	1-MB
Floppy Standard	1.44-MB	1.2-MB	1.2-MB	1.44-MB
Storage Bays	4	4	3	4
Total Slots	6	9	5	8
Starting List Price	**$1995**	**$2795**	**$3295**	**$2995**
Upgrade Path	ALR SuperCharged 486 CPU/Math Chip, 25-MHz i486 Module	ALR SuperCharged 486 CPU/Math Chip, 25-MHz i486 Module 33-MHz i486 Module	ALR SuperCharged 486 CPU/Math Chip, 25-MHz i486 Module 33-MHz i486 Module	ALR SuperCharged 486 CPU/Math Chip, 25-MHz i486 Module 33-MHz i486 Module

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Inside

When talking about the comprehensive nature of the computer reviews in *PC Magazine*, readers often ask, "How do you do it?" While no single person is responsible for everything that goes into a *PC Magazine* computer review, one person serves as the "point man" for the computer stories: Charles Rodriguez.

As product testing manager for PC Magazine Labs, Rodriguez oversees and coordinates the testing of computers. This includes everything from assembling components such as motherboards and power supplies into machines to just typing the word "BENCH" to execute the PC Labs benchmark tests. But the biggest challenge that Rodriguez has faced in his six-year tenure at the magazine was testing 62 computers in the span of two weeks, in order to implement the new PC story that picks up from its debut in the last issue.

As product testing manager for PC Magazine Labs, Charles Rodriguez oversees and coordinates all computer testing.

"With the vast number of motherboards, ROM BIOSes, disk and video systems out there, configuring a PC for testing is a daily challenge," Rodriguez says. "That challenge was increased with the number of machines involved and the short time frame." Directing a staff of three and working past midnight and weekends, Rodriguez and his crew rose to the occasion, completing testing and analysis of the 29 486/25 machines reviewed in the previous issue and the 33 systems you'll read about in this issue.

With the revised PC story format, *PC Magazine* is taking a new tack in delivering the information PC buyers need to make informed purchasing decisions. By compiling the expertise that Rodriguez and his staff have garnered from testing hundreds of machines over the years, we are able to characterize a machine's performance by contrasting it with all others in its class. We can also comparatively assess the performance of entire categories of machines. With this information, it is now easier for us to tell you which machines are at the top (and bottom) of their class, as well as steer you toward the right class of machine for your needs.

Inside, you will see a new look to the PC benchmark test information, a "bang for the buck" chart to help you identify real computing value for your dollars, and a "performance thermometer" to help you see how these 486 powerhouses stack up against other classes of machines. While these improvements will go a long way to making the PC stories more understandable, over time all *PC Magazine* feature stories will benefit from this more comprehensive approach. People like Rodriguez and his experienced staff are part of the answer to the question "How do we do it?"

—Robert W. Kane ■

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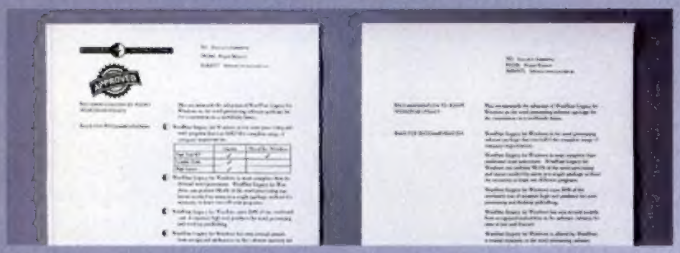

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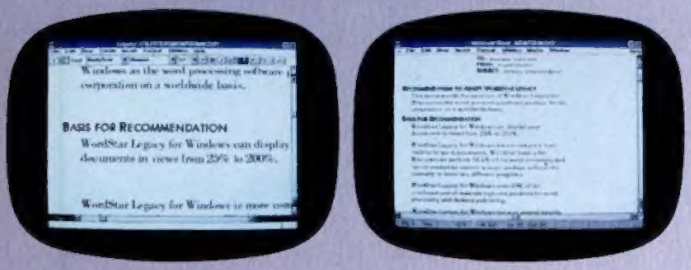

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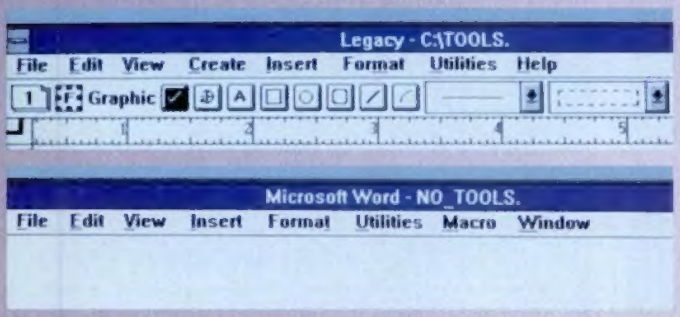

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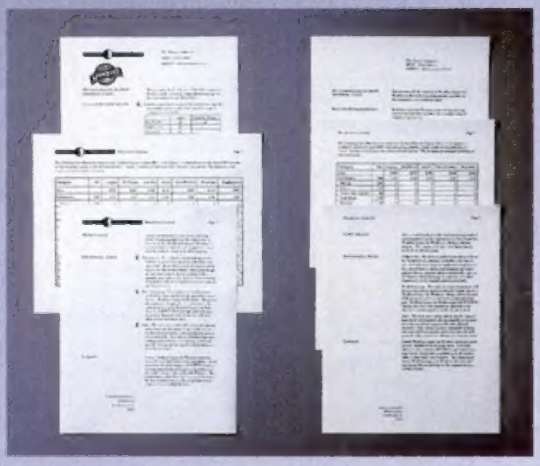

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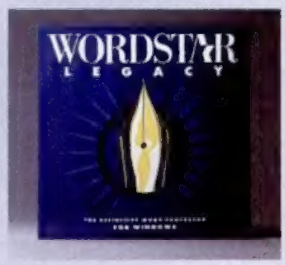

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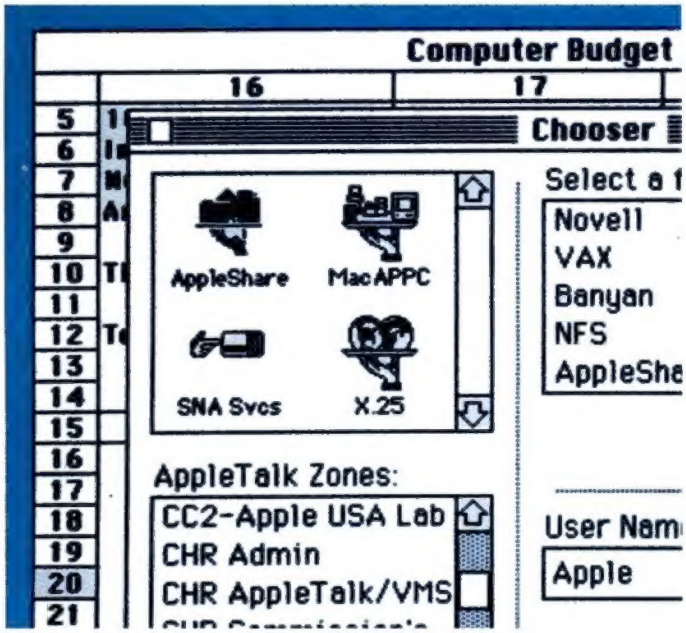
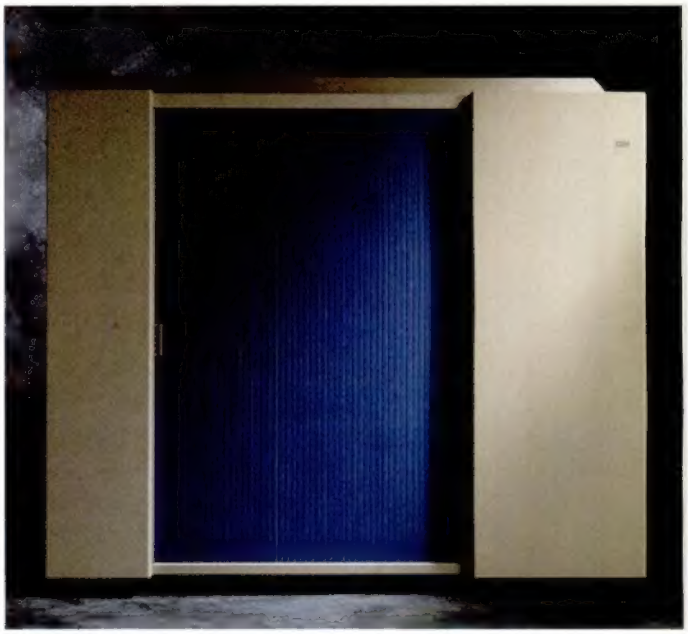
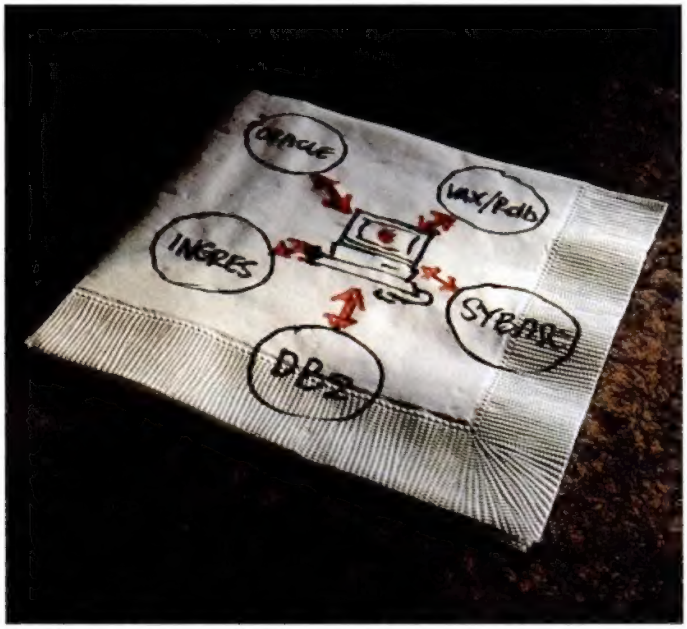


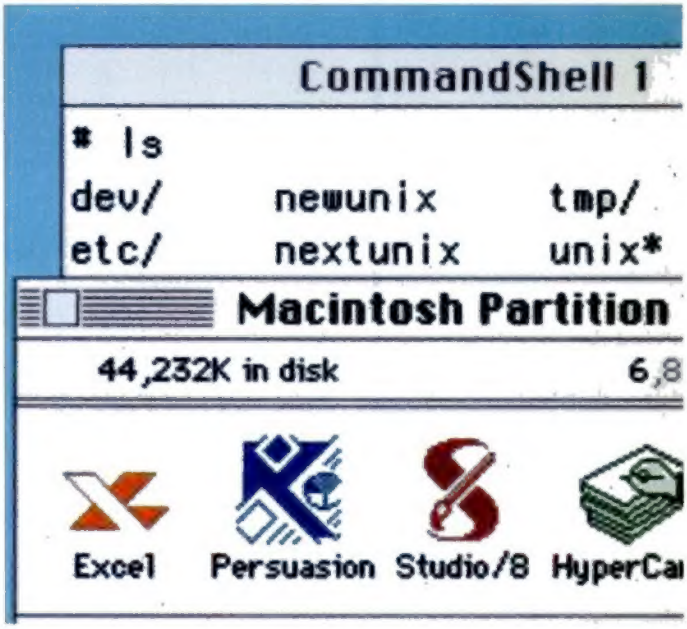
This is the Macintosh Chooser. A single point of access to a wide range of systems. The Chooser shows available network resources graphically and consistently. Just point the mouse and you're connected.



Macintosh offers an incredible range of tools for connecting with virtually any host-based environment, whether it's running SNA, TCP/IP, DECnet™, or OSI.



Apple's Data Access Language (DAL) adapts popular off-the-shelf database, spreadsheet, and data analysis software to major SQL environments. So nontechnical users can easily access remote databases.



Apple A/UX™ lets Macintosh run UNIX™ applications plus thousands of Mac® programs. At the same time you can run X-Window and MS-DOS applications, and cut, copy, and paste between any of them. No other desktop computer can do this.

to anything.

Macintosh shares data with DOS PCs via Novell, 3Com, Banyan, and more. Macintosh reads and writes DOS files on a floppy disk. Macintosh runs DOS programs. Maybe your next DOS computer should be a Macintosh.

Information isn't much good to people who can't get to it. Macintosh sorts out the complexities of multiple computer systems and presents vast information to people at the desktop in a single, consistent way.

While diversity may make life rich and fascinating, it makes life as an IS manager something short of serene.

What is politely referred to as the "multi-vendor environment" is an amalgam of disparate hardware, incompatible operating systems, dissimilar databases, and multiple networks. Nevertheless, IS people are expected to make these all work together in perfect harmony.

But lately, a lot of people are finding the source of their solution a pleasant surprise: the Apple® Macintosh® computer.

They're finding that Macintosh comes out of the box with sophisticated networking capabilities designed right in.

That Macintosh is open to virtually any host, any file server, or any database, through any network.

That Macintosh makes the desktop the place where diverse systems come together.

And that with Macintosh you can build systems that let even nontechnical users access information from the desktop, no matter where that information resides.

And because Macintosh works with all your networks, databases, and hosts in one consistent and graphic way, it delivers major savings in implementation and training.

In short, Macintosh gives you the power to make information systems more valuable to the people who use them. The power to be your best.®

Macintosh gives people a single, simple view of the information and services that can help them do their jobs and serve your organization. See for yourself. Call 800-635-9550, ext. 671, and we'll send you a free video showing how Macintosh helps unify complex systems.

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■ **Diamond's SpeedSTAR HiColor:** At this price, 32,000-color screens may soon be everywhere.
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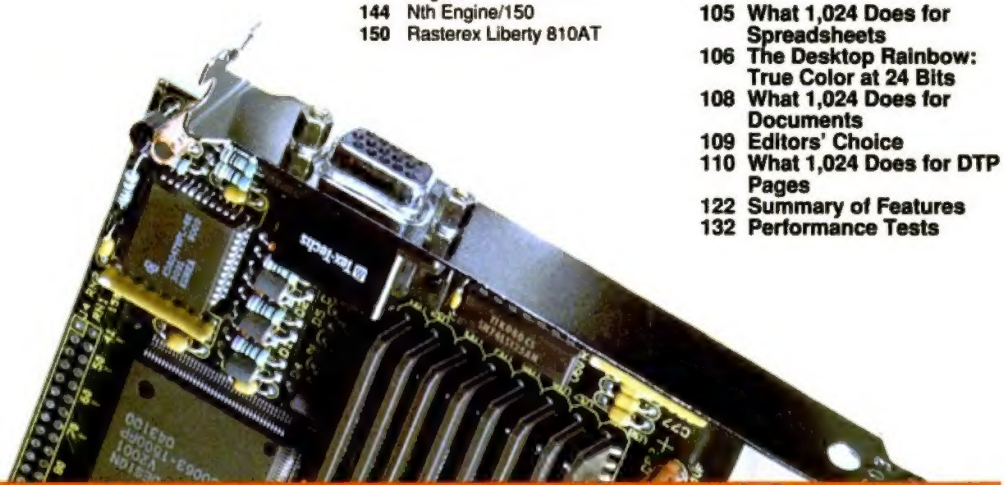

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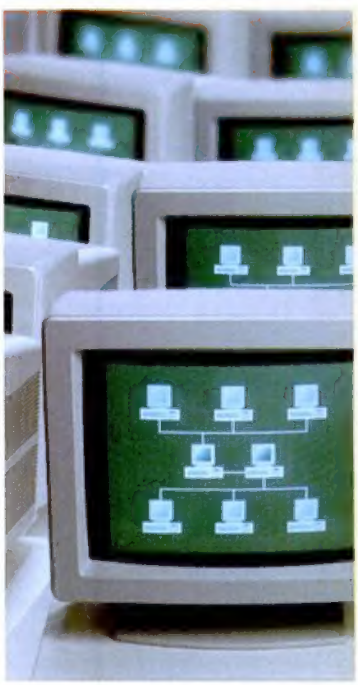

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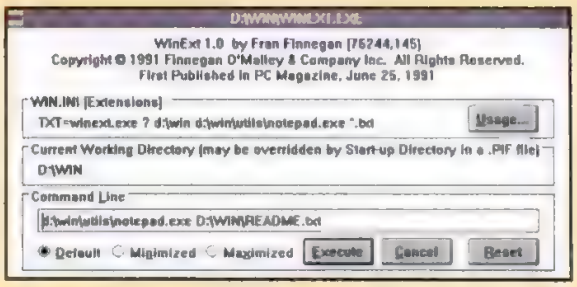

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What's the difference between an Austin and a Dell PC?

AUSTIN 486·33 EISA WINTOWER

$7,495

DELL SYSTEM 433TE

$9,649

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The Price.

Can two computer systems with similar features have such a huge difference in price? Yes! How? Just read the chart below.

What Do You Get From Austin?

- **Award-Winning Excellence**
  In under 3 years, Austin Computers has won 4 *PC Magazine* Editor's Choice awards...the most highly acclaimed award in the computer industry. When we won our latest award, they said, "When you combine...the attractive pricing with Austin's faster-than-average performance, quality components, expansion possibilities, and "made-in-America" philosophy, it's easy to give the Austin...an unqualified recommendation."

PC MAGAZINE EDITOR'S CHOICE

- **Fully Loaded System**
  We configure every Austin WinStation (Window Workstation) to include a monitor, video adapter, hard drive, floppy, keyboard, and full array of I/O ports. Then we preload with Microsoft Windows 3.0 and DOS 4.01. We even include a Microsoft mouse. Other peripherals and options are available. Call for details.

- **American-Made Quality**
  Austin WinStations, including the surface-mounted motherboards, are made and assembled in the USA! The latest design and manufacturing techniques allow us to offer you the highest quality products at the lowest prices!

- **GE On-Site, Next-Day Service**
  Every Austin desktop comes with 1 year of GE on-site service. That means we'll have a Service Engineer to your computer site usually within 24 hours! We even offer extended GE contracts for up to 5 years at the best rates.

GE Computer Service

- **Toll-Free, 1-800 Technical Support**
  If you ever have a technical question or just need information, you can call our highly trained specialists, free of charge.

- **Special Departments**
  Use our Certified NetWare Engineer to help you set up your own Local Area Network. Call us at **1-800-874-7182** and ask for the Networking Department. Austin Computers is a Novell Gold Authorized Reseller. We also have specific departments for VAR, Government, Education, and International clients. Ask about our quantity discounts.

Novell Gold Authorized Reseller

- **30-Day Satisfaction Guarantee**
  We want you to be 100% satisfied with your computer, your service, and us. That's why we give you a 30-day no-questions-asked, money-back guarantee.

- **100% Financing and Leasing**
  We offer 100% financing with our Austin Computer Systems Credit Card. Just call and we'll take your application over the phone.

What's The Big Difference?

Both companies give you high-quality systems, Editor's Choice awards, American-made quality, high performance, quality components, on-site service, full technical support, leasing options, 100% financing, and 30-day money-back guarantee. But, **Austin costs less!**

A close comparison...If you ignore the $2,154 difference.

Feature	**Austin 486/33 EISA**	Dell 433TE
486/33 MHz Processor	**Yes**	Yes
EISA Bus Architecture	**Yes**	Yes
330Mb Hard Drive	**Yes**	Yes
4Mb RAM	**Yes**	Yes
128K External Cache	**Yes**	Yes
VGA Monochrome Monitor	**Yes**	Yes
30-Day, Money-Back Return Policy	**Yes**	Yes
On-Site Service	**Yes**	Yes
Toll-Free Technical Phone Support	**Yes**	Yes
Leasing/Financing	**Yes**	Yes
Extended Warranty	**Yes**	Yes
Price	**$7,495**	$9,649*

How Can You Lose?

As *PC Magazine* said when we won our **first** Editor's Choice award, "Austin Computer Systems has a winning combination of classy parts, smart design, high performance, and aggressive pricing, all backed by a GE on-site service contract. How can you lose?" You can't! So...call us today!

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There is a

PC MAGAZINE EDITOR'S CHOICE
Editor's Choice 386/SX16 1990

PC MAGAZINE EDITOR'S CHOICE
Editor's Choice 386/SX20 U.K. 1991

$1090

AUSTIN 286/16
STANDARD CONFIGURATION
Microprocessor: 80286 running at 16MHz.
Special Features: GE on-site service.
Storage: 40Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 1Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: TTL monochrome monitor with video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

$1890

AUSTIN 386/SX16 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386SX running at 16MHz.
Special Features: Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service.
Storage: 40Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 2Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor with 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

$1990

AUSTIN 386/SX20 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386SX running at 20MHz.
Special Features: Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service.
Storage: 40Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 2Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

$2590

AUSTIN 386/25 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386 running at 25MHz.
Special Features: Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service. Small footprint chassis.
Storage: 90Mb IDE hard drive. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 2Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 286/16
1MB RAM AND 1 FLOPPY DRIVE
STARTING AT $1090 OR $33 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW		
	TTL MONO CHROME	VGA MONO CHROME	VGA COLOR 640 X 480
40MB IDE	$1090	$1255	$1470
90MB IDE	$1310	$1435	$1650
125MB IDE	$1440	$1565	$1780
200MB IDE	$1620	$1945	$2160

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

AUSTIN 386/SX16 WINSTATION
2MB RAM AND 1 FLOPPY DRIVE
STARTING AT $1490 OR $46 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW		
	TTL MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$1490	$1890	$2035
90MB IDE	$1755	$2095	$2216
125MB IDE	$1885	$2225	$2345
200MB IDE	$2285	$2605	$2725

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

AUSTIN 386/SX20 WINSTATION
2MB RAM AND 1 FLOPPY DRIVE
STARTING AT $1945 OR $56 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW		
	VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$1845	$1990	$2180
90MB IDE	$2025	$2240	$2380
125MB IDE	$2155	$2370	$2490
200MB IDE	$2535	$2750	$2870

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

AUSTIN 386/25 WINSTATION
2MB RAM AND 1 FLOPPY DRIVE
STARTING AT $2220 OR $67 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW		
	VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$2220	$2435	$2555
90MB IDE	$2400	$2590	$2735
125MB IDE	$2530	$2745	$2865
200MB IDE	$2910	$3125	$3245

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

Difference.

$3290

AUSTIN 386/33 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80386 running at 33MHz.
Special Features: 128K system cache. Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service. Small footprint chassis.
Storage: 125Mb IDE hard drive with 32K cache. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 4Mb RAM
Expansion: 7 expansion slots (6 16-bit and 1 8-bit).
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 386/33 WINSTATION
4MB RAM AND 1 FLOPPY DRIVE
STARTING AT $2820 OR $85 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
40MB IDE	$2820	$3035	$3155
90MB IDE	$3000	$3215	$3335
125MB IDE	$3130	$3345	$3435
200MB IDE	$3510	$3725	$3845

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

$3990

AUSTIN 486/25 WINSTATION
STANDARD CONFIGURATION
Microprocessor: Intel 80486 running at 25MHz.
Special Features: Internal 8K cache floating point unit. Pre-loaded with Microsoft Windows 3.0 and MS-DOS 4.01. Microsoft mouse. GE on-site service.
Storage: 125Mb IDE hard drive with 32K cache. 1.44Mb or 1.2Mb floppy disk drive.
Memory: 4Mb RAM (expands to 32Mb on system board)
Expansion: 8 16-bit ISA expansion slots
I/O Ports: 1 parallel and 2 serial ports.
Video: 14" VGA color monitor. 16-bit VGA color video adapter.
Keyboard: Enhanced 101 keyboard with tactile/click touch.
Compatibility: DOS, OS/2, Novell, Unix.

AUSTIN 486/25 WINSTATION
4MB RAM AND 1 FLOPPY DRIVE
STARTING AT $3990 OR $117 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 X 768 VGA COLOR
125MB IDE	$3690	$3990	$4185
200MB IDE	$4260	$4475	$4595
330MB SCSI	$4730	$4945	$5065
1.2GB SCSI	$6180	$6395	$6515

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.

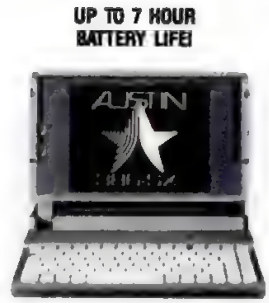
$6730

AUSTIN 486/33E WINTOWER
STANDARD CONFIGURATION
Microprocessor: Intel 80486 running at 33MHz.
Special Features: EISA bus architecture. Internal 8K cache and floating point unit. Optional 64K or 128K external cache. Landmark v1.14 rating-167.8 MHz. Power meter rated @ 14.93 MIPS. Shadow RAM. EMS LIM 4.0 support. Microsoft package. GE on-site service. Vertical chassis.
Storage: 330MB SCSI hard drive. 1.44 Mb or 1.2Mb floppy disk drive.
Memory: 8Mb RAM (expands to 64Mb on system board).
Expansion: 8 32-bit EISA bus master.
I/O Ports: 2 parallel and 2 serial ports.
Video: 14" VGA monochrome monitor. VGA video adapter.
Keyboard: Enhanced 101 keyboard.
Compatibility: Novell, DOS, OS/2 and Unix.

AUSTIN 486/33E WINSTATION
8MB RAM AND 1 FLOPPY DRIVE
STARTING AT $6730 or $177 PER MO.

CHOOSE HARD DRIVE BELOW	CHOOSE MONITOR BELOW: VGA MONO CHROME	VGA COLOR	1024 x 768 VGA COLOR
330MB SCSI	$6730	$6945	$7065
1.2GB SCSI	$7990	$8395	$8515

OTHER OPTIONS ARE AVAILABLE. CALL FOR DETAILS.



$2295

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STANDARD CONFIGURATION
Microprocessor: 80386SX running at 16MHz.
Special Features: Weight 6.1 lbs. without batteries. Notepad size. Dual removable battery packs for up to 7 hour battery life. Audio/Visual low battery warning indicator. Leather carrying case. Batteries and recharger included.
Storage: 20Mb hard drive. 1.44Mb floppy disk drive.
Memory: 2Mb RAM (expands to 8Mb on system board).
Expansion: 2 expansion pack slots. External VGA monitor port. External keyboard port. Printer port. 2 serial ports (1 for modem pack).
Video: Brilliant 10" VGA display with 640 x 480 resolution and 32-gray scale.
Keyboard: Low profile, full travel with embedded numeric keypad and 12 function keys.
Compatibility: DOS.

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CIRCLE 347 ON READER SERVICE CARD

Letters

WINDOWS: NOT SIMPLER, NOT SUPERIOR

Bong! William F. Zachmann's article in your March 26, 1991, issue struck a resounding chord in me. All this talk about how *Windows* is needed to insulate users from the dreaded C:\ prompt is hooey. My customers haven't seen it in years. When we set up a new system we put in a simple menu program (written by a MIS manager) started from the AUTOEXEC.BAT. Press 1 for *MultiMate*, 2 for *Lotus 1-2-3*, etc. Works fine on a five-year-old XT, very easy to use, and cheap!

C. Briant Wolfe
Trumbull, Connecticut

I do not count myself one of the *Windows*-cynic crowd (I am a DOS cynic), but Mitt Jones's review of *GeoWorks Ensemble* (First Looks, February 12, 1991) first piqued my interest, then depressed me. Here is a package that is in many ways superior to *Windows* and sports an OSF/Motif-compliant interface that will, in all likelihood, vanish from the whole scene. Software developers do not have sufficient resources to develop for multiple interfaces, and Microsoft has enough marketing push to shove *GeoWorks* out of the picture.

If the big players in the DOS world (read IBM and Microsoft) are really interested in providing better service to users, they would choose open standards and make it easier for developers to bring products to the users.

Mark Schroeder
Honolulu, Hawaii

I don't understand your magazine. *GeoWorks Ensemble* is the best piece of software that has ever run on my machine. Instead of giving this incredible achievement the front-page publicity it deserves, your magazine only mentions it as a "historical curiosity" for nonpower users.

It's bad enough that Microsoft was able to convince IBM to drop *Ensemble*, but that doesn't mean that you guys have to follow. Don't you see the need for a little diversity in the operating system market? Even Bill Machrone said that he uses "*GeoWorks Ensemble* on the road" and that "*Win* 3 definitely looks bad by comparison." Why not create a GEOS column for *GeoWorks Ensemble* users?

David Moore
Sunnyvale, California

First Looks

GeoWorks Ensemble Lays the Foundation For A Brave New OS

Our readers want more *GeoWorks Ensemble*, less *Windows*.

PC Magazine's relentless biased promotion of *Windows* and Microsoft is compromising the usefulness of an otherwise outstanding magazine. Wouldn't *PC Mag* serve its readers far better with a column on *WordPerfect*? Isn't it about time to get real again?

Nathaniel S. Weiner
Norwood, Massachusetts

I have read a lot about *Windows* in your magazine. I realize that you devote so much time to it because there are many *Windows* users out there who need help. I appreciate your commitment to supply this assistance.

However, this constant disagreement among you whether *Windows* is a good program or not is really rather pointless. Let those who like it, use it. Let those of us who are intelligent, ignore it.

Mary Doolittle
Jonesboro, Arkansas

Windows! Windows! Windows! Come on, guys! Let's hear *something*, anything about the *other* multitasking program—*DESQview*. Sure, *Windows* is the best thing since sliced bread, but there *are* other loaves that deliver. I multitask beautifully with *DESQview 386* and run *Windows* in a window. So why not a *DESQview* issue, or better yet, a column? Its versatility is matched only by its simplicity and ease of use. So, how about it?

Dave Kurzdorfer
Englewood, Colorado

If *Windows* is so intuitive, so natural, and so much simpler than DOS (echoes of John C. Dvorak's March 12, 1991, column), why is so much explanation needed? My copy of Que's latest tome on the subject runs over 600 pages.

In the process of worrying about all this, I've evolved Bossin's Law: The true usefulness of any technological innovation is inversely proportional to the amount of hype it gets.

Ben Bossin
Atlanta, Georgia

DOS BUYERS VERSUS DUKAKIS VOTERS

In response to David Welch's letter (March 12, 1991): There have been more copies of DOS sold than the number of people who voted for Dukakis *plus* the number of Edsels sold.

Jerry Van Cleeff
Montgomery, Alabama

COMPUTERS IN THE CLASSROOM

Donald W. Chilton (Letters, March 26, 1991) says that regarding classroom instruction, "nothing can possibly take the place of a real, live, caring human being in the grade-school environment." I agree,

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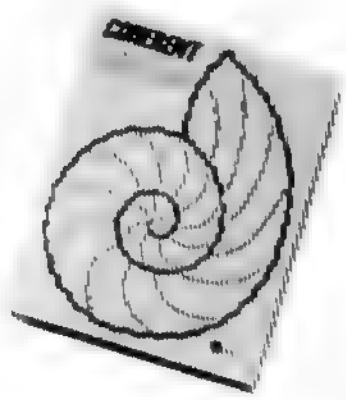

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but in most of America's classrooms we only get the "real" and "live" part. As an observer of public education for many years and the spouse of an instructor, I have seen a shocking number of teachers who fail to meet the criteria for being called either caring or human beings.

Why not replace this type of dead weight with computer-based instruction? Because with the introduction of such technology, the outmoded seniority system would first eliminate the youngest staff—often the most enthusiastic and best at communicating with students. You would be left with impersonal instruction backed up by the worst of all possible teachers.

Computers are only as good as their users. Until tenure and seniority are abolished or overhauled, the great new teaching technologies will be little more than expensive paperweights in the schools.

John H. Sayers
Morgantown, West Virginia

A UTILITY WORTH REPORTING

In your review of system setup and reporting software ("System Setup: The Inside Story," March 26, 1991), you should have mentioned *MSD*, a program that Microsoft throws in for free with copies of *Word* 5.5. It generates a very comprehensive report on a computer's setup. It shows your machine's BIOS, CPU, memory configuration, video system, network setup, CD-ROM, I/O ports, IRQ status, disk drives, and other valuable information.

Jonathan Woltz
Arlington, Texas

WHY DON'T YOU INCLUDE...

I'd love to see a short, regular column in *PC Magazine* in which users send in copies of their AUTOEXEC.BAT and CONFIG.SYS files, with explanations of what they're doing and why, along with any questions they might have.

Bill Seixas
Los Angeles, California

CURSOR KEY CONFUSION

Is anybody out there listening? Do laptop manufacturers understand the meaning of cursor control keys? Do the laptop designers ever use their keyboards? It appears not.

Your most recent review (March 12, 1991) reveals that only 7 of 42 portables have eight cursor control keys. None of the nine 286 notebooks do. Why?

Kevin Patterson
DeSoto, Texas

A WEITEK AND A 486

I want to disagree with a remark that Winn L. Rosch made in his minireview ("IBM PS/2 Models 90 and 95: True 486 Power at Last," February 26, 1991). He states that the omission of a Weitek 4167 socket doesn't matter because the i486 has a built-in coprocessor. If I pay over $15,000 for a top-end PC, you bet I want a Weitek socket.

Is anybody out there listening? Do the laptop manufacturers understand the meaning of cursor control keys?

It is interesting to note that properly designed software can utilize the i386 and i387 within the i486 and the W4167 all at once for maximum performance.

Ralph Kelsey
Rio Grande, Ohio

QUIETER COMPUTING

Upon receipt of my new 386/25, I had anxiously placed it on my desk and flipped the switch. I thought I was about to witness a shuttle liftoff. For several days I wrestled with the idea of putting up with the racket, but I finally realized that this was going to be unacceptable in my small office.

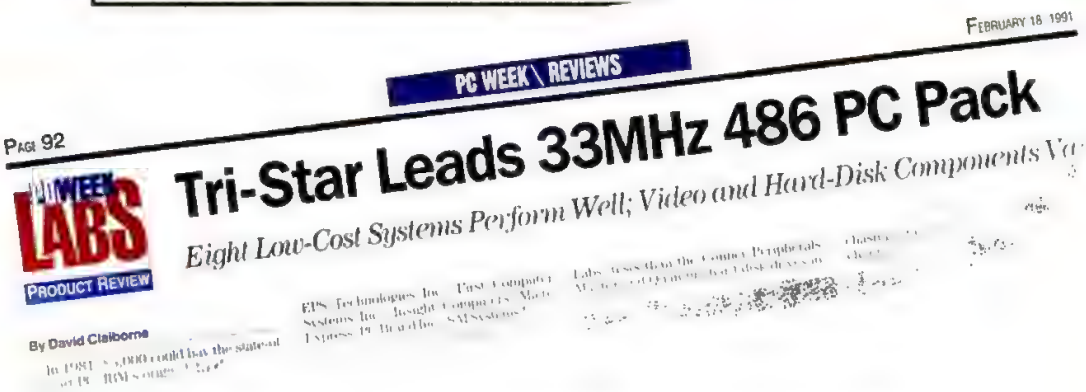
As you recommended (Advisor, February 26, 1991) I called PC Power & Cooling Systems, and they sent me a new power supply the next day. I couldn't believe it! The Silencer 270 is virtually silent.

Barrett Bryan
Atherton, California

MORE STREET PRICE APOLOGY

Commenting on the "street price" mentality (Letters, February 26, 1991), Thomas J. Plunkett writes that with a list price of $2.95, "*PC Magazine*. . .should sell on the street for about a buck and a

THE RIGHT DECISION


PC WEEK \ REVIEWS

FEBRUARY 18 1991

PAGE 92

LABS PRODUCT REVIEW

Tri-Star Leads 33MHz 486 PC Pack

Eight Low-Cost Systems Perform Well; Video and Hard-Disk Components Va

By David Claiborne

"Tri-Star is king of the 33MHz 486 Mountain."

PC WEEK

Analyst's Choice, February 18,1991

Tri-Star Computer continues to outdistance the pack as America's prefered supplier of high-end 486 Workstations. Read the reviews and you will understand why Tri-Star is the undisputed 486 champ.

"Tri-Star's 486/25 rates honorable mention for its thoughtful design touches, two year warranty and excellent service program."
PC Magazine
Editor's Choice Honorable Mention, September 11, 1990

"Tri-Star's edge is its good documentation and excellent service policy."
PC Sources
486/33 Lead Review, February 1991

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CIRCLE 121 ON READER SERVICE CARD

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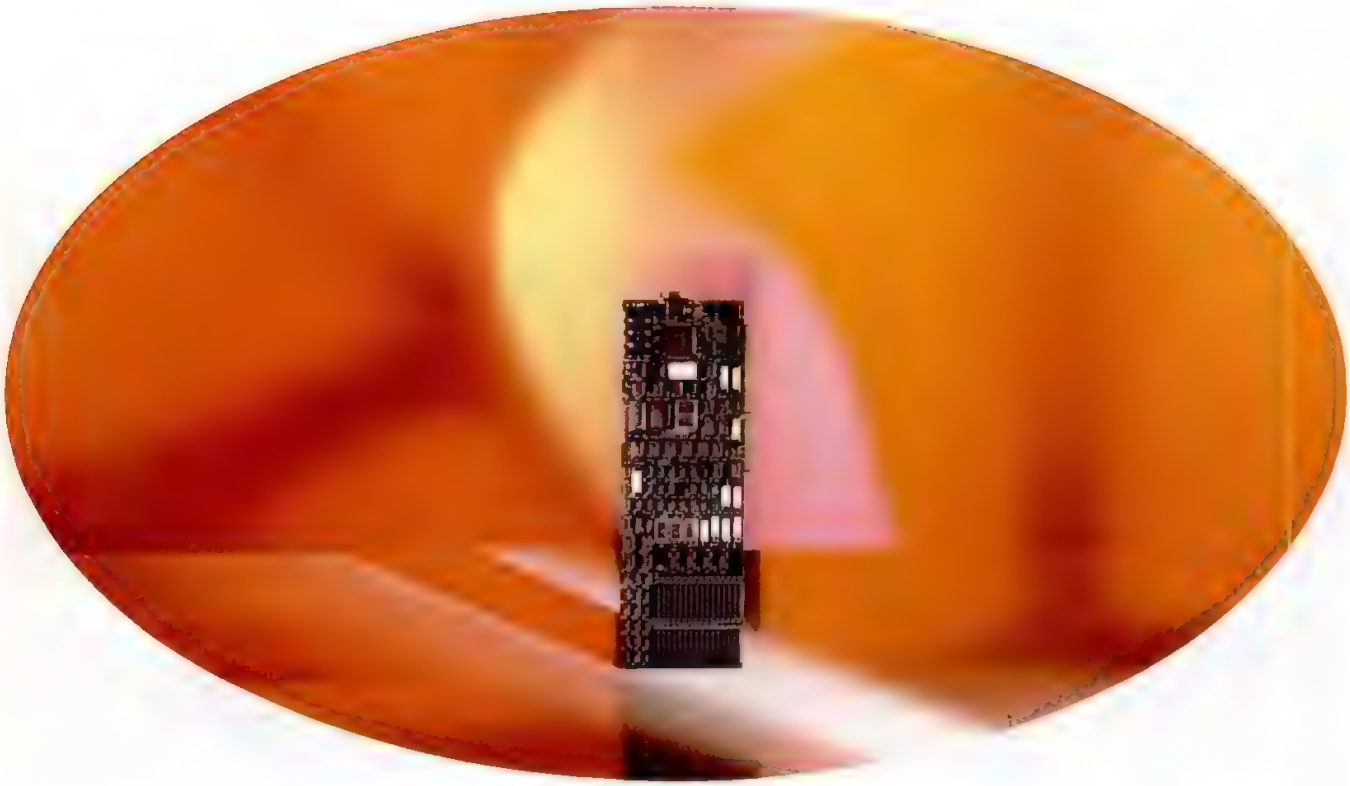

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CIRCLE 157 ON READER SERVICE CARD

Red Cross Virus. Ambulance randomly moves across bottom of display.

Friday 13th Virus. Alias "Black Friday." Erases programs when you try to run them.

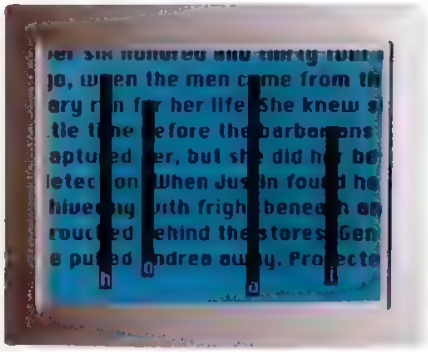
Disk Killer Virus. Alias "Ogre." Causes unexpected formatting of your hard disk.

Stoned Virus. Alias "Hawaii." Data loss caused by damage to directory and FAT.

Datacrime Virus. Adds garbage to files and reformats disk.

AirCop Virus. Alias "Red State." Attacks boot sector on non-write-protected diskettes.

Ping Pong Virus. Alias "Bouncing Ball." Wipes characters off the screen.



Falling Letters Virus. Characters fall to the bottom of the monitor. Creative, but a real nuisance.

With over 50 new viruses each month, who knows what's next.

You Could Get By Without An Anti-Virus Program. Then Again, So Could These.

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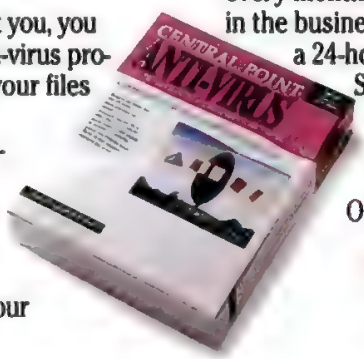

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CIRCLE 162 ON READER SERVICE CARD

half!" Well, I don't know where Mr. Plunkett has been buying his magazines. It is common knowledge that the best deals on

> Can you imagine anyone willing to use a few hundred floppies (and an afternoon) to back up their systems?

equipment can be negotiated with dealers from whom either large quantities or steady business can be assured. Magazines work the same way. I pay about $1.14 for each issue of *PC Magazine*. . .it's called a subscription!

Marc I. Leavey
Baltimore, Maryland

PETZOLD MISSES THE POINT

In his sidebar "The GUI of the 1990s" (Environments, January 29, 1991, page 359), Charles Petzold stated the case of OS/2 versus *Windows* clearly and concisely but missed the point entirely. Sure most of us would love to own a Ferrari or a Porsche, but very few of us can afford the time, energy, and money that such a car requires, so we settle for something that works at a reasonable price. And watch with envy those who can afford the commitment a Ferrari requires.

Kim Mosher
Byron, California

BAR CODING FOR THE MASSES

Your article on envelope printers ("Name and Address for Less: Envelope Printers Cut Your Costs," *PC Magazine*, January 29, 1991) was very timely, given the acceptance of new postal rates on January 23 that increased the discounts for various presorted mail classifications. Of particular interest to the small-volume mailer is a newly approved category offering a 2-cent discount for individual piece, pre-bar-coded mail, effective later in 1991.

Your article noted two software programs that will accomplish the bar coding for mass mailers. We regret that our program, *Address Plus Barcode*, has not yet received sufficient exposure to have been included in your article. Though targeted at the small-business and home user at $75 per copy, our program qualifies as a full-address list manager.

James T. Madry, President
Computer Systems Associates
Statesville, North Carolina

TAPE SHOULD BE STANDARD EQUIPMENT

As usual, your review of 22 486/33-based EISAs ("Unleashing EISA's Power," April 16, 1991) was informative. However, I am very concerned that none of the systems included tape backups.

Years ago, people rarely bothered to back up their 10MB hard disks onto the 10 to 30 required floppies. Now we are looking at systems ranging from 200MB to 1.2GB. Can you imagine anyone willing to use a few hundred floppies (and an entire afternoon) to back up their systems?

The sad fact that none of the manufacturers include the tape backup in their standard configuration should deprive all of them of an "Editors' Choice" rating. However, *PC Magazine* could set the standard by requiring tape backups in the review criteria.

Gary Oppenheimer
New York, New York

CORRECTIONS & AMPLIFICATIONS

In a sidebar of the printer blockbuster, "How to Transform Your LaserJet into a High-Flying PostScript Machine" (November 13, 1990, page 202), the results we printed for the Pacific Data Products' PacificPage cartridge were misleading. Further investigation shows that the problems were due to a bug in the PC Magazine Labs printer graphics test.

HOW TO WRITE TO PC MAGAZINE

We welcome your comments, complaints, insights, and suggestions. Please send them to Letters, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see page 8 for access information). All letters become the property of *PC Magazine* and are subject to editing. ■

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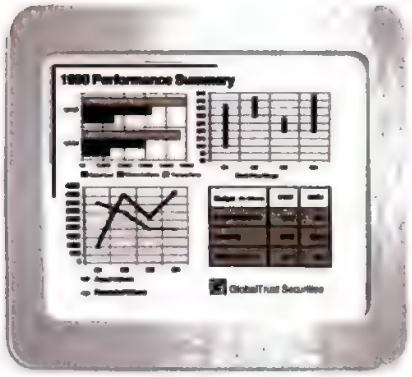

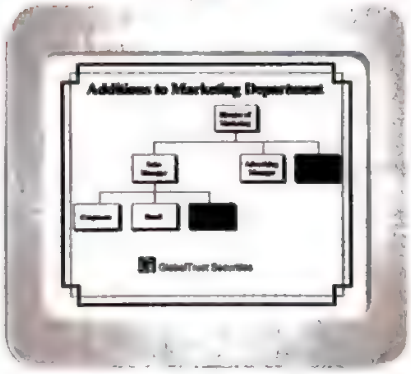

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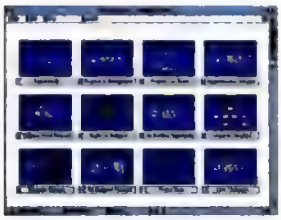

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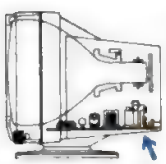
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by
Gus Venditto

Pipeline

A Look at the Trends Shaping the Personal Computer Market

Is OS/2 Destined to Be Nothing More than the QEMM-Killer of 1992?

IBM is clearly jealous.

It was OS/2 that was supposed to be the hot topic of 1991, not *Windows* 3.0.

It was OS/2 that was supposed to sell millions of copies and change peoples' attitudes about how they used their personal computers.

And it was OS/2 that was supposed to entice software developers to plan their futures around a graphical operating system.

A lesser company would simply give in, abandon OS/2, and throw its support to *Windows*. IBM is not that kind of company.

With a directive that comes straight from chairman John Akers, IBM is digging in its heels with OS/2 and launching a campaign to prepare DOS and *Windows* users for an OS/2 future.

From IBM's viewpoint, the deck is stacked against them. *Windows* is monopolizing users' attention as new applications and utilities continue to be released, and Microsoft is dazzling the development community with visions of its OS/2 NT operating system that will do everything: multitask DOS, run *Windows* applications using 32-bit instructions, and work the same on a wide range of processors, from 386s to SPARC machines to MIPS computers (see Pipeline, April 16, 1991).

When you try to pin Microsoft down, however, it's clear that this vision may not be realized until 1993 or later.

And with Microsoft calling its operating system OS/2 NT (for New Technology), IBM knows that OS/2 2.0, the first 32-bit DOS-compatible operating system for the PC, is in danger of being perceived as passé months before it's introduced.

IBM hasn't been all that much better than Microsoft in delivering on the promise the company made for OS/2 in 1987; it has delivered OS/2 releases on every promised date, but there was always something missing (printer drivers, video drivers, code optimization).

But after four years, IBM believes it's on the verge of finally getting things right with the 32-bit version of OS/2.

OS/2 2.0 won't be finished until later in the year, but IBM has begun to give public demonstrations in order to prevent OS/2 from becoming completely overlooked.

And while we're all weary of IBM's OS/2 promises, the demo of 2.0 showed a product that anyone who's struggled to run more than one program at a time will crave—especially those who have struggled with *Windows* for the last year.

The basic specs on OS/2 2.0 have been publicly discussed on a number of occasions; It will run in a 32-bit flat memory space; it will provide an unlimited number of DOS sessions; and it will accommodate installable file systems. The file system that will be shipped with OS/2 2.0 (High Performance File System) will have an enhanced FAT that will accept long filenames.

One of the few changes in the software design from last year is that now OS/2 designers are taking pains to ensure that *Windows* will run under OS/2 2.0 with no loss of performance.

In a demonstration, IBM showed identical machines running *PageMaker* under *Windows* 3.0 and an early version of OS/2 2.0; the performance was identical. And when DOS applications running under both environments were compared, OS/2 2.0 was much faster.

One of OS/2 2.0's advantages is a version of DOS rewritten for the 32-bit OS/2 model; all applications run in their own memory space and can't crash the entire system. And because OS/2 provides services like print spooling, EMS, and network access, more RAM will be available to DOS applications (see table).

For once, IBM is describing OS/2 as something that meets people's needs *today*. The company describes OS/2 as an integrator—an operating system that can give better performance for running DOS and *Windows* applications.

IBM is talking about an operating system that will give you the kind of multitasking and memory use that *QEMM*, *386MAX*, and *Headroom* are making halting attempts to provide today.

And with a price expected to be close to $100, IBM may do a lot better than the 600,000 copies the company says OS/2 has already sold.

That's a far cry from where OS/2 started life. So far, in fact, that IBM is even considering a new name.

The company says it's asking customers for suggestions, so speak now while the product is still in development.

Judge Reverses Order; dBASE Copyright Upheld

Ashton-Tate has received a major reprieve on its ownership of the *dBASE* copyright.

After stunning the *dBASE* community by ruling that Ashton-Tate's copyright on the *dBASE* language was invalid, a federal judge has rescinded his own ruling.

The ruling and its reversal were made in a Los Angeles U.S. District Court where Ashton-Tate is suing Fox Software for infringing on the *dBASE* copyright.

The judge reversed his own decision after the U.S. Register

CONTINUES ON PAGE 30

IBM CLAIMS DOS WILL HAVE MORE RAM UNDER OS/2 2.0 THAN UNDER WINDOWS 3.0

	OS/2 2.0	Windows 3.0 Standard	Windows 3.0 Enhanced
RAM available for DOS apps (with EMS and mouse)	633K	571K	569K
RAM available for DOS apps with a LAN attached	633K	491K	489K
EMS 4.0 available	32MB	None	16MB

Under OS/2 2.0, DOS applications will receive services such as LAN and mouse support from OS/2, reducing the memory required for a DOS session. IBM made these estimates using DOS 5.0 for the *Windows* session; under DOS 3.3 or 4.0, the memory available to *Windows* would be much lower.

Pipeline

CONTINUED FROM PAGE 29

of Copyrights issued a statement that maintained Ashton-Tate's copyright registration had been properly filed.

AT&T Spins Off Unix Lab, Novell Becomes Shareholder

As part of its long-running effort to convince the world that Unix is not a proprietary operating system, AT&T has sold more than 20 percent of Unix Systems Laboratory (USL), the AT&T subsidiary that develops the multiuser operating system.

Eleven companies have jumped at the opportunity of having inside access to AT&T's Unix development. Most of the investors, such as Motorola and Sun, have a clear vested interest in the technology.

Also on the list is one company that has done very well with multiuser software on its own: Novell.

AT&T plans to retain at least 60 percent of USL and will not be making a public offering. All of the investors so far have bought their shares privately.

NEC, Fujitsu, Oki, Amdahl, and Toshiba are also among the shareholders.

Broderbund, Electronic Arts Call Off Merger

Broderbund and Electronic Arts were not able to come to terms on the merger they recently announced.

Problems developed when top management at the two companies tried to assign responsibilities to each other.

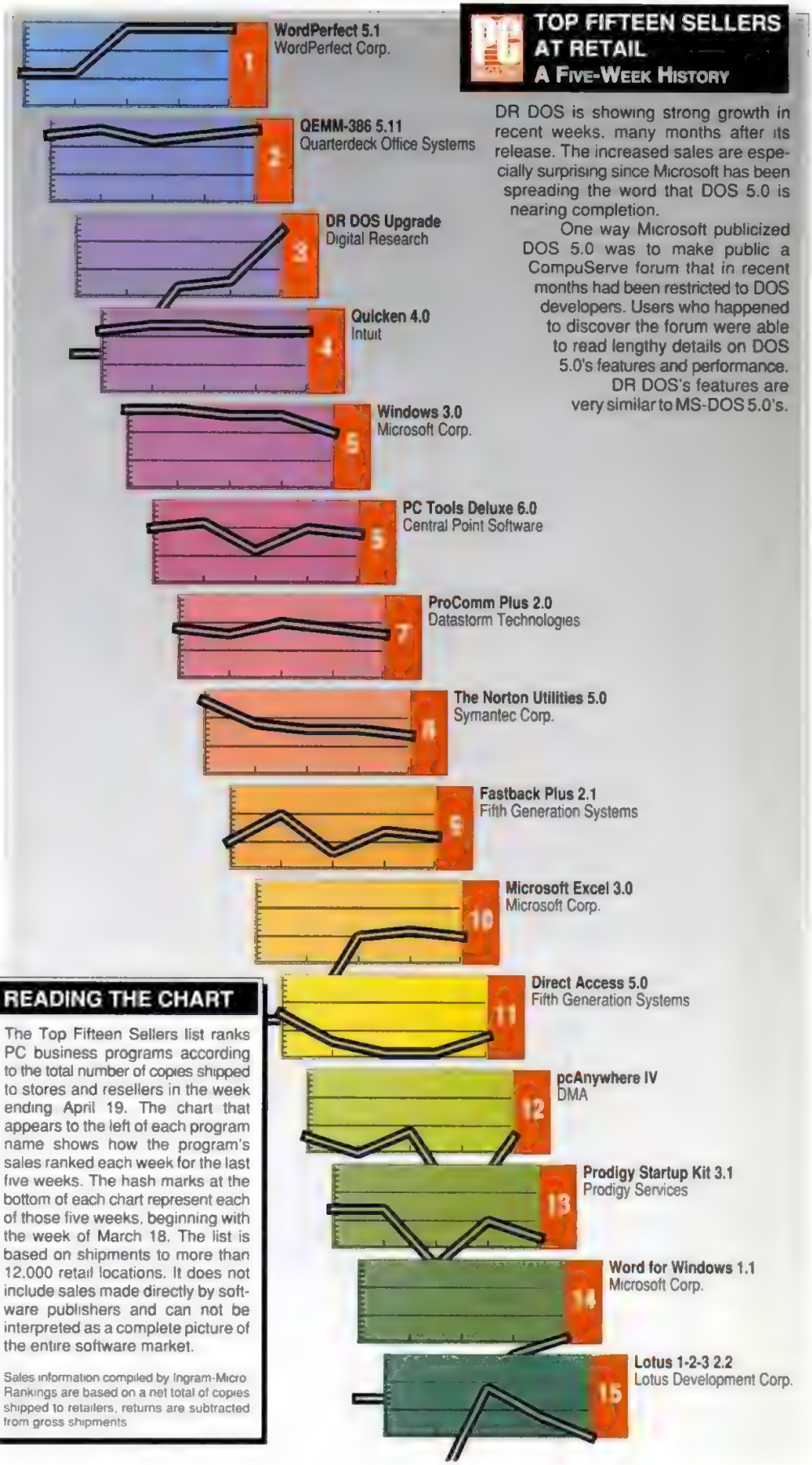
Update on WordStar's Plans for Windows Word Processing

Recently, this column incorrectly reported that WordStar had bought *Legacy*, the Windows word processor from NBI.

In fact, WordStar is merely marketing *Legacy* temporarily until it completes its own *Windows* word processor; NBI continues to own the product.

Meanwhile, WordStar has acquired LifeTree, which will furnish word processing tools for future Wordstar products. ■

TOP FIFTEEN SELLERS AT RETAIL
A FIVE-WEEK HISTORY



DR DOS is showing strong growth in recent weeks, many months after its release. The increased sales are especially surprising since Microsoft has been spreading the word that DOS 5.0 is nearing completion.

One way Microsoft publicized DOS 5.0 was to make public a CompuServe forum that in recent months had been restricted to DOS developers. Users who happened to discover the forum were able to read lengthy details on DOS 5.0's features and performance.

DR DOS's features are very similar to MS-DOS 5.0's.

READING THE CHART

The Top Fifteen Sellers list ranks PC business programs according to the total number of copies shipped to stores and resellers in the week ending April 19. The chart that appears to the left of each program name shows how the program's sales ranked each week for the last five weeks. The hash marks at the bottom of each chart represent each of those five weeks, beginning with the week of March 18. The list is based on shipments to more than 12,000 retail locations. It does not include sales made directly by software publishers and can not be interpreted as a complete picture of the entire software market.

Sales information compiled by Ingram-Micro. Rankings are based on a net total of copies shipped to retailers, returns are subtracted from gross shipments.

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- *PC Magazine*, "Don't pass up the ZEOS . . . solid construction, flexible design and escape-velocity performance make it a top flight choice."
- *InfoWorld*, "We find the ZEOS 386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent."
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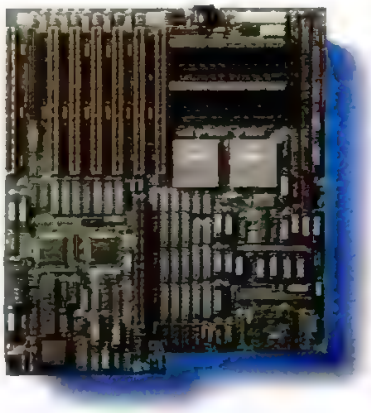

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First Looks

Hands-on Reviews of the Latest Products

Zenith Is First with Low-Power 386SL Notebook

PREVIEW
by Mitt Jones

Given that Zenith Data Systems (ZDS) participated in defining the power-management capabilities of the Intel 386SL chip set, it comes as no surprise that the company is winning the race to get the first SL-based machine to market.

The surprises, pleasant and otherwise, come more in the form of how ZDS implements the SL's power-management features. Our $4,999 Zenith MastersPort 386SL evaluation unit fell a good bit short of production quality, but it provided a glimpse at the capabilities of Intel's SL chip set.

The MastersPort, which weighs 6.8 pounds and measures 1.8 by 12.4 by 8.3 inches (HWD), departs from ZDS's disappointing MinisPort notebook design. Instead of a battery-backed RAM disk and a 2-inch floppy disk, ZDS equipped the MastersPort with a 60MB Conner Peripherals hard disk and a 3.5-inch floppy. Rather than a small, dim CGA display, the MastersPort boasts a 9-inch, 32-shade VGA display that ranks among the best. 2MB of 80-nanosecond RAM (expandable to 8MB), a 64K static-RAM cache, DOS 4.01 and *Windows* 3.0, round out the list of standard equipment.

The $4,999 MastersPort SL runs its 386SL at 5 and 20 MHz.

As with most ambitious laptops, the MastersPort provides both manual and automatic control over which components are operable at any given time, but the SL chip set allows the MastersPort greater control over the extent to which it needs to cut power, when to do so, and when to bring the components back to life.

In rest mode, for instance, the MastersPort completely shuts down its CPU and all peripherals, leaving power only to the memory and memory-control circuits. The MastersPort can be brought back to life by a push of the power button, automatically by a system alarm, or when a call comes in to the optional, 2,400-bps internal modem.

Unlike much of its competition, the unit also manages to come back to life without a

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HiColor Chip Brings 32,768 Colors to $695 VGA Board

HANDS ON
by Don Hyatt

In the world of graphics adapters, color and money have always had a direct connection: The more you paid, the more color you got. Diamond Computer Systems' SpeedSTAR HiColor breaks the chain.

The $695 board rivals more-expensive graphics adapters, such as the TrueVision Targa and Matrox Illuminator-16, with its ability to handle images of photorealistic quality.

With 1MB DRAM, a Tseng Laboratories ET-4000 chip set, and featuring the Sierra SC1148 RAMDAC chip, the Diamond HiColor displays 32,768 simultaneous colors in 800-by-600, 640-by-480, and lower resolutions. The board also has a 1,024-by-768 mode at a maximum of 256 colors.

To ensure that all of this color has a practical use, Diamond bundles *Windows* 3.0 drivers for both 800-by-600 and 640-by-480 resolution (at 32,768 colors) and *WinRIX Junior*, a *Windows*-based photo image editor developed by Rix Softworks.

In addition to the supplied software, many other *Windows* applications already support 32,768 colors; these include *CorelDRAW*, *Image Prep*, *PageMaker*, and *PhotoStyler*. Although the Diamond driver and other Super VGA drivers give *Windows* the ability to display more than the default of 20 colors, very few applications actually use the extra colors.

One advantage that the DiamondStar board has over other Super VGA boards is that its driver provides access to all available colors from the *Windows* Control Panel for use in defining the desktop colors; many VGA boards running in

CONTINUES ON PAGE 37

PHOTOGRAPHY: THOM O'CONNOR

386SL

CONTINUED FROM PAGE 35

glitch under *Windows* 3.0.

The machine's standby mode also shuts down the processor, as well as the display backlighting and hard disk. The 1.3-pound battery pack and internal backup battery will sustain standby mode for as long as 12 hours—far less than the two weeks or so in rest mode, but the machine comes out of standby mode instantaneously, making it a more appropriate option for brief shutdowns.

In most other respects, ZDS's implementation of the SL's power-management features reflect a focus on security and data integrity. For instance, the ROM-based setup program allows two levels of system password protection—supervisor and user—and three separate configuration profiles, which include current settings for all power-management features.

ZDS chose not to implement two of the more obvious capabilities of the SL chip set. Neither the serial nor the parallel port can be shut down during normal operation, even using the always-off option most laptops provide. A ZDS spokesperson explained that automatic shutdown could foil programmable serial mice, and that disabling the ports would extend battery life only minimally.

The 386SL chip set has the ability to slow down the processor to any speed, but ZDS provides only two: 5 and 20MHz.

Future implementations of these capabilities would not be terribly difficult since the company uses Flash ROM to allow end-user upgrades of the power-management code via floppy disk.

With battery conservation features disabled, our preproduction unit ran for 2 hours and 19 minutes on the PC Magazine Labs rundown test, a good bit less than both its 3-hour rating and the 3:08 rundown time of a similarly-equipped Compaq LTE 386s/20.

Even so, judging by preliminary PC Labs power-draw measurements, the power-consumption characteristics of the MastersPort under normal operating conditions are roughly equivalent to those of the 386s/20; the Compaq's greater battery longevity results from its heavier, more-capacious battery, not a less power-hungry design.

The MastersPort's forte is in its rest mode and standby modes, which appear to draw exceptionally little power. Glitches with this version's implementation of the rest mode frustrated our efforts to arrive at results for battery life under normal intermittent use, but ZDS's 8-hour estimation seems to be in the right ballpark.

When it comes to speed, the machine performed marginally slower than the Compaq on most PC Labs tests, scoring 3.32 seconds on the 80386 Instruction Mix, 0.66 seconds on Conventional Memory Access, and 65.24 and 6.12 seconds on Small and Large DOS File Access tests. The corresponding numbers for the Compaq LTE 386s/20 are 3.09, 0.45, 60.6, and 5.89.

This first implementation of the 386SL SuperSet undoubtedly is not the most extravagant buyers can expect. It's likely that Compaq and a few other R&D-intensive companies could design an SL-based machine that cuts power more aggressively. Still, the MastersPort 386 SL's excellent VGA display and keyboard and its respectable power-management features make it a machine to watch, and one well worth considering. ■

FACT FILE

Zenith MastersPort 386SL
Zenith Data Systems, 2150 E. Lake Cook Rd., Buffalo Grove, IL 60089; 800-553-0331.
List Price: With 2MB RAM, 64K SRAM cache, 60MB hard disk, 1.44MB floppy disk drive, VGA LCD, one mouse/keyboard port, one serial port, one parallel port, DOS 4.01, *Windows* 3.0, $4,999; 2MB RAM module, $399; additional battery packs, $115; internal V.42 2,400-bps modem, $349.
In Short: This first implementation of the Intel 386SL chip set combines a well-designed, 6.8-pound laptop with fairly traditional, if somewhat-enhanced, power-management strategies.

CIRCLE 706 ON READER SERVICE CARD

NEW RULES IN THE POWER MANAGEMENT GAME

by Gus Venditto

The effort to squeeze more computing time from the typical laptop nickel cadmium battery has cost companies like IBM, Compaq, and Toshiba millions of dollars in R&D, and given them a competitive advantage.

With Intel's 80386SL chip, the rules of the battery-watch game have been rewritten, giving every laptop designer a better shot at building a lighter-weight, longer-running laptop.

Intel's 386SL Microprocessor SuperSet (the SL chip itself and its peripheral controllers) promises to drastically extend battery life by supporting incremental processor slowdowns, by closely monitoring active and nonactive system components and peripherals, and by tightly integrating the SL processor with the system control circuitry. The upshot? You might get weeks from a single charge without powering down.

Like AMD's recently introduced AM386 chip, the 386SL uses a static design, allowing it to run as low as 0 MHz, as high 20 MHz, or somewhere in between without losing the contents of its registers.

The SL takes power conservation even further. Intel includes the circuitry for interfaces to both an ISA bus and individual peripherals on the 386SL.

To make the most of this potential, Intel designed a companion chip, the 82360SL Peripheral I/O Subsystem, which provides the logic that allows the processor to manage the flow of current to all of the I/O devices (floppy, keyboard, ports, etc.), slashing the amount of current that would normally be wasted communicating with idle devices.

The greatest power savings will be realized because the chip includes "I/O traps" that monitor read and write activity. When activity is detected, a system interrupt is generated. Firmware in the laptop will establish the parameters for cutting and restoring power.

To isolate such power management schemes from software running on the laptop, Intel has created a new level of hardware control: System Management Interrupts (SMI). These interrupts will supersede any instructions being executed in the system and provide a fail-safe mechanism for storing any data that is being moved when a power-down goes into effect.

SMIs are flexible; they can be generated by activity on a peripheral. For example, a laptop created for traveling sales representatives could be optimized for overnight database updates. The SMI would be generated by an incoming call that would turn on the processor and hard disk, but not the keyboard or screen.

Laptop power management schemes will vary dramatically from one 386SL machine to the next. Clever engineers will have plenty of room to make the best use of the SL chips. And clever marketers will have an array of new designs that they can target to specific users. ■

SpeedSTAR

CONTINUED FROM PAGE 35

256-color can provide users with only 20 basic colors for Control Panel's use.

In addition to the *Windows* drivers, Diamond's card also comes with typical Super VGA software, including *Windows* 3.0, *AutoCAD*, and *VersaCAD* drivers for 16 and 256 colors at 640-by-480, 800-by-600, and 1,024-by-768 resolutions. The HiColor also includes the RIXAI 8514 emulator, the VMODE setup program, VESA BIOS extensions, video diagnostics, a driver for *Ventura Publisher* 2.0, and an ANSI.SYS driver to provide ANSI video capabilities for all resolutions. The VMODE program sets up the HiColor VGA for different types of monitors, including those that refresh the screen at an eye-pleasing 72 times a second.

The Diamond HiColor VGA displays rich and stunning color, but it does impose a small performance penalty compared with 256-color VGA, because of the additional computation needed to generate the extra colors (see sidebar). The PC Magazine Labs test we used to evaluate the board revealed no compatibility problems in the 32,768-color modes when the *Windows* drivers were running (even though the drivers were due for further revision before the board was put on sale).

FACT FILE

SpeedSTAR HiColor
Diamond Computer Systems Inc., 532 Mercury Dr., Sunnyvale, CA 94086; 408-736-2000.
List Price: With 1MB RAM, *Windows* 3.0 driver, *WinRIX Junior*, $695
In Short: The first VGA adapter to use the Sierra HiColor RAMDAC, the Diamond SpeedSTAR HiColor displays 32,768 on-screen colors without any significant performance handicap.

CIRCLE 480 ON READER SERVICE CARD

15-BIT COLOR NOW FITS SUPER VGA BUDGETS

At the heart of the Diamond SpeedSTAR HiColor VGA are two chips, the very fast Tseng Laboratories ET-4000 VGA chip and the Sierra SC1148 RAMDAC.

Tseng's chip is similar to chips at the heart of many VGA and Super VGA boards. Sierra's RAMDAC expands the range of the Tseng chip and most other VGA controller chips so they can display 32,768 colors. This is accomplished using board designs that require only minor modifications.

A RAMDAC (Random Access Memory Digital-to-Analog Converter) digests the digital data in the memory of a video card and feeds analog signals to a video monitor.

The more commonplace VGA RAMDACs, from chip houses such as Brooktree, produce 256 colors on-screen from 8 bits of data. The Sierra SC1148 interprets 15 bits of color data, yielding 32,768 colors on-screen at once, while retaining pin compatibility with Brooktree's chip.

For hardware and software engineers alike, it is easy to design a product to use the Sierra RAMDAC. Diamond has designed its VGA card so that either the Sierra HiColor RAMDAC or a simpler 8-bit RAMDAC can be snapped into place during the final assembly of a card.

Tseng Labs has extended its VGA BIOS to ease the development of software that uses the Sierra chip. A program asks the VGA BIOS whether the HiColor RAMDAC is present on the video card. If it is, the program uses a BIOS call to set up the card in one of the four 32,768-color modes: 320-by-200, 640-by-400, 640-by-480, or 800-by-600 resolution.

Regardless of whether the video card is set up for 256 or 32,768 colors, the steps that a programmer uses to color a pixel in video memory are almost exactly identical.

First, the pixel number within video memory is computed.

Because each pixel requires 1 byte of video memory when running in a 256-color mode, and 2 bytes when 32,768 colors are displayed, programs that use the HiColor modes must double the pixel number.

Dividing the pixel number by 64K reveals the pixel's segment location; the remainder from the division is the offset within the segment. Using the segment and offset values, the programmer can read or change specific pixels.

Because the design of the HiColor VGA allows software to read and write data from video memory, many graphics applications can embrace HiColor VGA with little or no change.

That is *not* true of the Edsun CEG RAMDAC, which doesn't have the ability to read anti-aliased data from video RAM directly.

The 32,768-color HiColor VGA could be a natural successor to today's prevalent 256-color VGA cards. 15-bit video offers near-photographic realism, acceptable to everyone except commercial artists and publishers.

With at least half a dozen 32,768-color VGA cards expected by midsummer, the street price of a HiColor VGA shouldn't be much higher than what you would pay for a similar 256-color VGA card.—*BM*

In most Super VGA boards, 256-color displays look flat because they portray an average available color. When dithering is used to simulate more colors, images look fuzzy. With more colors available, photorealistic images are rendered on-screen with little compromise. They hardly seem different from printed photos.

The Diamond HiColor is one of the first VGA cards to offer 32,768 colors by implementing Sierra's new RAMDAC. Cardinal Technologies (Lancaster, Penn.) and ICON Int. (Charlottesville, Va.) will be the next in line. It is the harbinger of a more natural and richly colored desktop. ■

The same image in 32,768-color mode (left) and in 16-color mode on the SpeedSTAR HiColor card.

PacificPage XL Cartridge Races Through PostScript

HANDS ON
by Edward Mendelson

The worst thing about PostScript printing is the waiting. To eliminate the wait you could spend up to $10,000 on a high-speed printer or $999 on Pacific Data Products' PacificPage XL.

The PacificPage XL consists of two pieces of hardware: a PostScript emulation cartridge that plugs into your LaserJet IIP or III series, and a 2MB LaserJet memory board that has an i960 RISC processor mounted on it for high-speed graphics processing. The system provides the fastest PostScript printing available on a desktop.

The innovative part of this system is the memory/processor board. When you use your LaserJet in its native PCL mode, the board works like any LaserJet memory board and increases the printer's graphics capability and its storage space for downloaded fonts.

When you use the PacificPage PostScript cartridge in tandem, the i960 on the board speeds printing. In informal tests, the XL typically outperformed HP's Adobe-licensed PostScript by a factor of 7 to 1.

This speed boost affects graphics performance far more than text printing. Compared with the HP cartridge, the PacificPage speeded text printing by a few seconds—not enough to justify buying the cartridge.

It does have one text printing advantage. The PacificPage is compatible with both standard Type 1 Adobe-style hinted PostScript fonts and the so-called "Type A" or "QEM" hinted PostScript fonts that Bitstream's Fontware can create from Fontware outlines. Also, the native 35 PostScript-compatible fonts in the XL are Bitstream designs, some of them slightly superior to Adobe's versions.

The cartridge component of the XL package is the latest version of Pacific Data's standard PostScript cartridge, the PacificPage Personal Edition. The cartridge uses the PhoenixPage PostScript interpreter, one of the best of the PostScript clones. Earlier versions of the cartridge lacked a few characters from the standard PostScript character set; all are present in the latest model.

The PacificPage almost equals the Adobe-licensed HP PostScript cartridge for the LaserJet IIP and III series and the Adobe PostScript cartridge for the LaserJet II in its text printing quality. The PacificPage renders Type 1 soft fonts well, but in text sizes like 12 point it loses some of the details of complex characters and exaggerates others.

It coarsens the fine pen strokes in the medieval-looking Duc de Berry font from Adobe and Linotype's *Type Before Gutenberg* package, and the subtle diamond-shaped period used in the font is rendered as a shapeless blob. The Adobe interpreter in the HP and Adobe cartridges gets these details right.

At large display sizes, and at very small text sizes like 6 point, the PacificPage XL and the Adobe cartridges are more closely ranked. With small-size type, where the rasterizer sometimes has to shift individual characters slightly to the left or right in order to align vertical strokes with pixel boundaries, the PacificPage sometimes produces more regular spacing than Adobe, sometimes less.

The PacificPage's memory management seems slightly less effective than HP's. When I downloaded a file with nine soft fonts into a LaserJet III with a total of 5MB RAM, the PacificPage simply refused to print, but kept flashing the printer's status lights until I pressed the reset button. The HP cartridge had no trouble with the same file, although it failed when I tried again with one more added font. These are tests that are more extreme than any real-world printing, however.

As a graphics printer, the PacificPage has no evident flaws, although shading sometimes differs slightly from the corresponding Adobe output. The PacificPage swiftly and accurately renders some test EPS files that other clone interpreters distort, and had no trouble with any of the large and complex images I used for testing.

Unlike the HP PostScript cartridge, the PacificPage lets you switch from PostScript to PCL mode without turning off the printer. A software switch is included in the package plus a version of Bitstream's *FaceLift* with scalable *Windows* fonts to match the 35 in the cartridge.

A LaserJet III with a PostScript cartridge is the most flexible desktop printer you can find, but it is generally hampered by slow-printing graphics and slow-downloading soft fonts. The PacificPage XL doesn't solve the downloading problem—the bottleneck is probably the parallel port on the LaserJet itself. But it's the cleanest solution to the graphics speed problem.

If you're looking for PostScript graphics and can accept slight weaknesses in Type 1 soft-font rendering, you'll find the PacificPage XL best. ■

PacificPage XL teams a Postscript emulation cartridge with a RISC-based accelerator board.

FACT FILE

PacificPage XL
Pacific Data Products, 9125 Rehco Rd., San Diego, CA 92121; 619-552-0880.
List Price: $999.
Requires: LaserJet IIP, III, IIID, or IIIP.
In Short: A combination PostScript cartridge and memory processor board that provides the fastest PostScript printing on a desktop.

CIRCLE 705 ON READER SERVICE CARD

PACIFICPAGE XL BEATS HP ON LASERJET POSTSCRIPT PRINTING

We conducted these tests while printing on an HP LaserJet III using a 33-MHz 386. An Intel 960 RISC processor on the accelerator board helps the PacificPage XL print graphics more than six times as fast as the HP PostScript Cartridge. There's only a small advantage in the speed of printing pages of text.

	PacificPage XL	HP PostScript Cartridge
Graphics page (EPS and vector)	35 sec.	3 min. 37 sec.
Text (1 page, 2 soft fonts)	2 min. 32 sec.	2 min. 42 sec.
Text (2 pages, built-in fonts)	35 sec.	45 sec.

PHOTOGRAPHY: THOM O'CONNOR

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- ❑ Guthrie
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- ❑ Jewel
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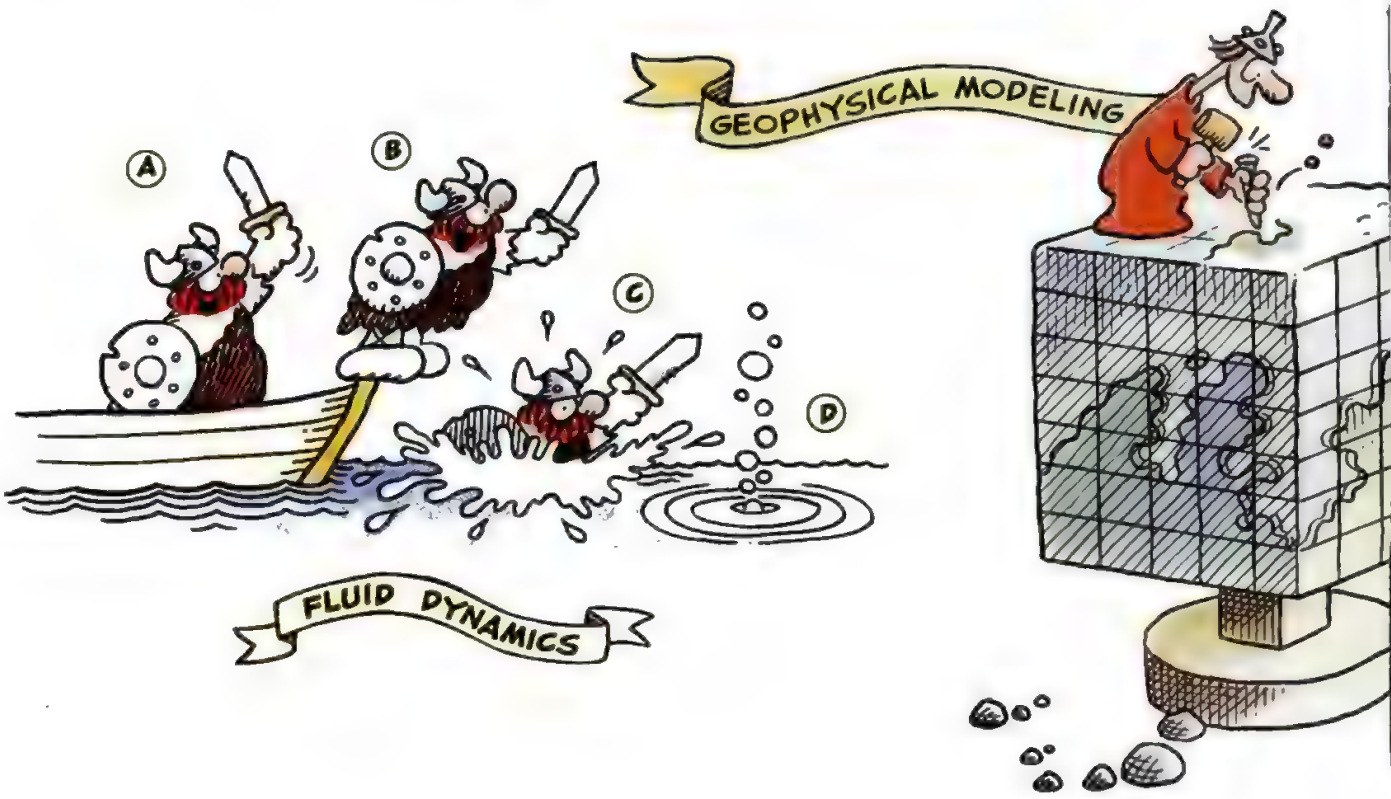

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PhotoStyler: The Only Image Editor You'll Ever Need

Knockoff of Mac's PhotoShop Brings 24-Bit Editing to PCs

HANDS ON
by Alfred Poor

Imitation is the sincerest form of flattery. And the $795 *Photo Styler* from U-Lead Systems heavily flatters the finest image-editing program available—Adobe Systems' *Photoshop* for the Macintosh.

Like its Macintosh role model, *PhotoStyler* offers scads of tools to provide total control over image creation and editing. The tools are presented in easy-to-use menus and toolboxes, with a sharp-looking interface. *PhotoStyler* is also one of the first *Microsoft Windows* image-editing programs to work with 24-bit color.

The program works with the full range of images: black-and-white, 256-level gray-scale, 16-color, 256-color, RGB 8-color, and 24-bit (16.7 million–color) images. And images can be converted from one type to another, so, for example, you could color-reduce a 24-bit image to a gray-scale image for printing. In the 16.7 million–color 24-bit mode you gain full access to all the program's image-editing features.

The program can also read and write files in a wide range of file formats: TIFF, *Windows* bitmap (.BMP), .PCX, .GIF, Targa, and EPS.

The program pits you against a daunting array of tools and options, but floating toolboxes ease navigation. There are 14 paint tools and 16 tools just for selecting parts of images. With the paint tools you can blur, smudge, sharpen, lighten, or darken parts of the image.

You can select areas by square, rectangular, circular, or elliptical masks, or you can use the "magic wand" to select areas of similar color. You can use an eyedropper to pick up a specific color, and you can zoom in on an image up to a 16:1 ratio.

There are also text tools, a scratch-pad dialog for experimenting with the myriad paint settings, and drawing tools, airbrushing, and fills. A "rubber stamp" tool can be used to clone one part of an image somewhere else.

Many of the tools reveal extensive optional settings when you double-click on them. You can set the sensitivity of the magic wand to control how close a color must be in order to be included in the selection. The Gradient Fill options let you select nonlinear fills along with options on how the colors are to appear. Again, an option box lets you preview the effect.

In addition to the tools, there are a full complement of menu-bar commands. The Edit menu includes a handy Undo that works on the last procedure. Some of the more novel commands are scanner control (so far the Microtek and HP scanners are supported) and a menu to handle full-color separation.

Other menu items include a Transform option that allows you to flip, skew, rotate, resize, and otherwise distort your image. The Image menu includes a selection of filters for smoothing or sharpening your image, or applying unusual effects such as emboss, mosaic, motion blur, whirlpool, wave, pinch, and punch.

Windows makes all of this power and flexibility relatively easy to tap. Printers and display options are already part of your *Windows* setup. The program will run on a standard VGA display with only 16-color support, but you will want a minimum of 256 colors to take advantage of the program's capabilities, and a higher-resolution display is also helpful so you can see more of the image at one time.

You will need plenty of memory and disk storage space because 24-bit color images grow large quickly, and because the Undo feature requires a correspondingly large temporary storage space.

A small sample image with a complex background and a gradient fill took up about 100K as a 16-color image, 200K as a 256-color image, and more than 600K as a 24-bit (16.7 million–color) image. It's not uncommon for 24-bit images to require 1MB of storage. And although my test machine had 8MB of memory, there was often less than 4MB available during the evaluation.

The installation is straightforward, but the documentation is the weakest part of the program. Because of the high demand for this program, U-Lead began shipping *PhotoStyler* before the main reference manual was ready. The early documents we looked at proved adequate but were not especially well organized.

On-line help is available, but many of the items offer too terse a description. The brightest note is the tutorial manual, which exposes you to a manageable set of operations using sample files included on the disk.

PhotoStyler does it all: paint, edit, process, and print. It can work with gray-scale and color images, it can produce color separations, and it can read or write just about any bit-mapped image file format you have. You can learn the rudiments quickly, but it may take you forever to outgrow. ■

PhotoStyler does it all: paint, edit, process, and print images. Effects like texture mapping and spherical distortions are part of its rich toolset.

FACT FILE

PhotoStyler
U-Lead Systems Inc., 680 Knox St., Torrance, CA 90502; 213-538-8911.
List Price: $795.
Requires: 2MB RAM; hard disk; EGA, VGA, Super VGA, XGA, 8514/A, or 24-bit display supported by *Windows*. Mouse or *Windows*-supported pointing device, printer, and scanner recommended.
In Short: The only image editor you will ever need, *PhotoStyler* handles images from black and white to full 24-bit color in a variety of file formats. Its tools are flexible and customizable as well as plentiful.

CIRCLE 703 ON READER SERVICE CARD

After 20 Million Pages Of PostScript Color Output, The Last One Looks As Great As The First.

MacWorld World Class Award
September 1990

PC Magazine Editors Choice
November 14, 1989

POSTSCRIPT

Features That Will Color Your Perception Of Business And Design Forever

- Compatible with Macintosh computers, IBM PC's and clones and other popular systems
- 35 resident Adobe PostScript typefaces all scalable and rotatable
- Model 30*i* has standard 8 MB RAM/1 MB ROM
- Model 10 has standard 5 MB RAM expandable to 8 MB RAM
- Model 10 prints letter- and legal-size paper and transparencies
- Model 30*i* prints letter-size and 11" x 17" paper and transparencies
- AppleTalk*/RS-422, RS-232 serial and Centronics* parallel interfaces provide compatibility with most micro, mini, mainframe and workstation hosts
- External SCSI interface supports up to seven additional hard drives of unlimited size
- 68020 MPU-based controller plus exclusive QMS ASAP™ technology means fast first-page-out performance
- Prints high-quality Adobe PostScript text and graphics at 300 x 300 dots per inch
- HP-GL* emulation software included

QMS ColorScript Printers... Brilliant *and* Resilient

Since 1987, QMS ColorScript™ 100 printers have produced over 20 Million hard copies and transparencies around the world! And because this color technology is engineered to use new ink with each print, the last page literally looks as bright and true as the first. This reliable QMS® technology has been united with the industry standards of Adobe® PostScript® and PANTONE®* Color to put exciting, persuasive color at your fingertips page after page.

Presenting The ColorScript Model 10 Printer

If it's dynamic presentations you're after, you need the Model 10. From business presentations to training programs, the Model 10 delivers vibrant, visually exciting colors that help you communicate ideas clearly. QMS screen angling technology and special presentation inks make these unusually captivating colors possible. And it's a proven fact that color presentations increase audience information retention and raise a recipient's tendency to act upon the information. So, in today's competitive business environment, the key question becomes, "Can we afford *not* to have the power of color?"

The ColorScript Model 30*i* Printer, Strictly For The Image Conscious

Extremely low cost Pantone-approved proofs in about 60 seconds. If you're a graphic designer, commercial artist or publisher it's easy to see how the Model 30*i* is revolutionizing your business. The QMS ColorScript 100 Model 30*i* is changing the relationship between speed, quality and cost by allowing you to do your job faster, cheaper *and* better!

The Model 30*i* is the first true "what-you-see-is-what-you-get" color printer. The colors you see on a Pantone-approved monitor are the same colors you'll see on a Model 30*i* proof *and* the same colors you'll see on the finished, printed piece. And the standard 11" x 17"/A3 paper handling capacity allows you to design actual size 8 1/2" x 11" full bleed proofs with crop marks.

True Adobe PostScript Guarantees Compatibility

Since Adobe introduced the PostScript page description language in 1984, it's become the industry standard for electronic printing and publishing. And with the QMS ColorScript 100 Model 10 and Model 30*i*, you get guaranteed compatibility and consistency. PostScript imitations, on the other hand, may not be 100 percent compatible with Adobe's PostScript.

Two Top Performers Right Out Of The Box

Whether you choose the Model 10 or the Model 30*i* you can be up and running within minutes. Both printers are designed for maximum compatibility with Macintosh® computers, IBM® PC's and compatibles as well as many other systems. And, for additional support, QMS's technical and service professionals are standing by to assist you with answers that will get you up to speed fast. Call us today and we'll help you decide which printer best suits your needs. Or FAX QMS Product Information at **(205) 633-4866.**

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PANTONE Colors generated by QMS PostScript printers are four-color simulations and may not match PANTONE-identified solid color standards. Use current PANTONE Color Reference Manual for accurate color.
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CIRCLE 259 ON READER SERVICE CARD

Toshiba's T3200SXC: Active-Matrix Screen Delivers Full VGA Color at 17 Pounds

HANDS ON
by Patrick Howard

The technical term for the VGA-color LCD screen technology used in Toshiba's new T3200SXC is thin-film-transistor (TFT) active matrix. In the vernacular just say "wow."

The colors are bright and bold; images are crisp. In short, there's no difference in quality between Toshiba's LCD and a color VGA monitor.

But such high-quality commands a high-price. The 20-MHz 386SX T3200SXC costs $7,249 with 1MB RAM, a 1.44MB 3.5-inch floppy disk, and a hefty 120MB 19-millisecond hard disk. That's $2,850 more than Toshiba's T3200SX, comparable in every way except for its 16-MHz 386SX processor, and gas-plasma VGA screen. And, because color LCDs require so much power, Toshiba has added this color option to its AC-only line of larger chassis machines.

Toshiba's primary source for its 10.4-inch diagonal screen is Display Technologies, a joint venture between Toshiba and IBM, Japan. The system was a Paradise chipset.

If you have been disappointed by the level of quality of color LCD screens in the past, it is probably because they've used a passive-matrix technology. Passive-matrix design uses a driver for each row and column of pixels on the screen to turn them on and off. Since each pixel receives a pulse for only a fraction of the time that the entire row and column is charged, the result is a limited range of control voltages (brightness) per pixel.

In active-matrix screens, each pixel is controlled by its own transistor; therefore, each pixel is charged continuously. As a result, the picture is much brighter and sharper, and exhibits none of the streaking or shadowing that is characteristic of passive-matrix screens.

Another advantage is that the screen is easily viewed from any angle—important if you'll use the computer to make presentations to small groups. With passive-matrix displays, you have to be directly in front of the screen for an optimal view.

There is a drawback to active-matrix screens, though: They are much more difficult to manufacture. Each active-matrix color VGA panel requires nearly one million transistors perfectly arrayed to control the red, green, and blue pixels. Even in a high-tech assembly plant, it's an expensive task. Consequently, they can cost $2,000 to $3,500 more.

Just as the color screen pushes the bounds of current technology, the size and weight of the T3200SXC push the bounds of portability. The unit measures 4.3 by 14.6 by 15.6 inches (HWD) and weighs 17 pounds. Toshiba makes good use of the unit's large footprint by offering lots of expansion capabilities, which effectively lets the T3200SXC serve as a desktop computer.

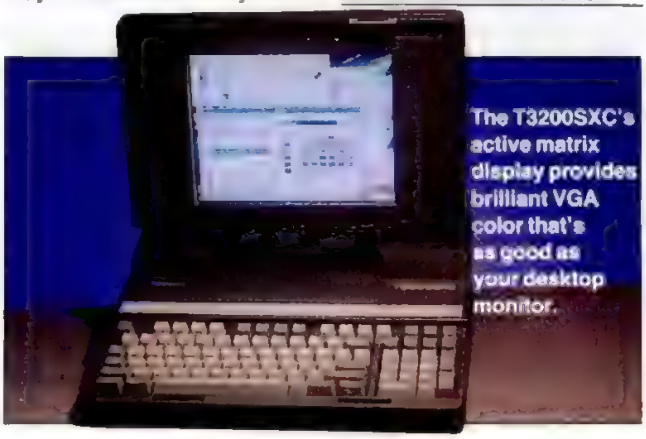
The unit holds up to 13MB RAM. A full-length 16-bit expansion slot accepts ISA boards, and a second slot accepts either half-length 8-bit ISA boards or 16-bit Toshiba boards, such as an Ethernet adapter board ($559). A third slot is reserved for a proprietary 2,400-bps modem ($279). If you want more slots, Toshiba offers an expansion chassis that provides five 8-bit slots. The chassis and required interface card cost $950.

Because of the quality of the LCD screen, you probably won't need to connect an external monitor to the T3200SXC when using the computer as your desktop system. The only reason to buy an external monitor is if you want a higher resolution than the supported 640-by-480 of the built-in screen. If so, you'll also need to buy a Super VGA card, since the unit's built-in VGA port also supports only 640-by-480 VGA.

As attractive as the T3200SXC's color screen is, the unit's size, price, and inability to run on battery power make it impractical for many portable users. But as a tool to enhance sales presentations or as a computer that you can easily move between home and office, the T3200SXC has few rivals. ■

List Price: Toshiba T3200SXC, with 1MB of RAM, 120MB hard disk, $7,249. Toshiba America Information Systems Inc., Computer Systems Division, 9740 Irvine Blvd., Irvine, CA 92718; 800-457-7777.

CIRCLE 702 ON READER SERVICE CARD



The T3200SXC's active matrix display provides brilliant VGA color that's as good as your desktop monitor.

Expand Your Field of Vision

HANDS ON
by Bill Howard

Some VGA-equipped laptops like the Toshibas don't use the top and bottom half-inch of the display in text mode. That's because VGA text mode is 400 lines deep, while graphics mode is 480. *Laptop UltraVision*, a $69.95 display enhancer by Personics Corp., expands your display vertically so you can use your entire screen. You won't need it to fix every laptop; many already have an expand-font or stretch-font option in the setup menu. How do you know if your laptop will benefit? Run a graphics program, then a text-only program. If the screen display compresses vertically, then you're a candidate.

The rest of *Laptop UltraVision* is similar to the desktop version and works with any EGA or VGA laptop. If your applications allow, you can display 25, 36, 50, or 63 vertical lines on a VGA screen (on an EGA the maximum is 43). Unlike desktop *UltraVision*, you are limited to 80 columns across. You can also choose a box or underline cursor, change color-to-gray mapping, and invoke different text fonts. Some fonts are novelties only (Old English, Broadway); others provide noticeably bolder, darker, easier-to-read fonts. ■

List Price: *Laptop UltraVision*, $69.95. **Requires**: EGA or VGA display, 16K RAM, DOS 2.0 or later. Personics Corp., 63 Great Rd., Maynard, MA 01754; 800-445-3311, 508-897-1575.

CIRCLE 433 ON READER SERVICE CARD

PHOTOGRAPHY: THOM O'CONNOR

Our Latest PostScript Printer Technology Impressed The Experts...

MacUser, Editor's Choice Award (Eddy), Jan. 9, 1991

PC/Computing, Most Valuable Product, Nov. 1990

BYTE, Editor's Product Merit Award, Jan. 1991

Personal Publishing, 1990 Outstanding Achievement Award

POSTSCRIPT™

QMS-PS 410, 815 & 825 PostScript Laser Printers

- ESP - Emulation Sensing Processor (printer interprets incoming printer language and switches automatically)
- SIO-Simultaneous Interface Operation (allows the printer to receive data from three interfaces simultaneously)
- LocalTalk, RS-232C serial and Centronics parallel interfaces (connects to IBM® PC's, Apple® Macintosh® computers and most mini computers and mainframes)
- 45 resident Adobe PostScript typefaces (all can be scaled from 4 points upward, rotatable, all with multilingual character sets)
- Front Panel Display on QMS-PS 815 & 825 (16-digit multilingual LCD array conveys printer status, allows user to quickly configure printer)
- Resident HP LaserJet Series IIP & PostScript emulations (prints PostScript & HP applications, HP-GL emulation cards available)
- QMS ASAP III Technology and 68020 Microprocessor (exclusive technology means fast first-page-out performance)
- PS Executive Series™ Utilities Software (to easily set printer parameters)

...So We Decided To Give Them More Of A Good Thing.

Before we developed the QMS-PS® 410 four page-per-minute laser printer, we performed one very important task. We listened to what you wanted. Then we engineered a printer light years ahead of the rest with features that aren't available on other printers at any price.

And now, QMS brings you more of a good thing. The QMS-PS 815 and 825. Two eight page-per-minute laser printers with all the leading edge features of the 410 *plus* enhanced processing speed, an increased duty cycle and an easy-to-read, multilingual front panel that lets you quickly configure the printer to suit your specific needs.

Award-Winning Simplicity

How did these printers capture the imagination of an entire industry? The answer is, quite literally, simple! These leading edge printers are so simple to operate they seem to "think for you." Each printer features ESP* (Emulation Sensing Processor) which allows them to interpret incoming data and automatically choose the appropriate printer language without changing switch settings or sending complicated software commands. And to make things still simpler, the 410, 815 and 825 can receive data simultaneously to LocalTalk®, RS-232C serial and Centronics® parallel interfaces, which makes them the best on the market for mixed computer environments. All this and more is the result of QMS's exclusive ASAP™ III technology (Third Generation Advanced System Architecture for PostScript). And it's this proprietary QMS* technology that wins awards *and* customers.

True Adobe PostScript Plus HP Emulations

Whether you choose the 410, 815 or 825, you'll enjoy the desktop design flexibility of the latest version of Adobe® PostScript®. This most recent version includes the output enhancement of Adobe Type Manager™ (ATM). All printers come standard with 45 resident typefaces scalable from 4 points upward and fully rotatable. These PostScript printers guarantee compatibility with thousands of useful PostScript applications currently on the market.

For even greater flexibility, these printers feature standard HP® LaserJet® Series IIP emulation to support non-PostScript printing applications. And a variety of options makes the printers easily expandable. HP-GL® emulation cards, HP compatible font cards, memory upgrades and extended paper handling capabilities are all currently available.

Expert Service And Support

As a recognized leader in PostScript printer technology, QMS maintains a commitment to customer satisfaction by providing free, responsive technical support. And to keep your QMS printer operating at its peak, QMS National Service offers a variety of service options. Call us today and see how QMS quite simply makes the best PostScript laser printers in the world. Or FAX QMS Product Information at **(205) 633-4866.**

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*patent pending

CIRCLE 164 ON READER SERVICE CARD

Textra: $500 Worth of Word Processing Features Packed Into a $95 Package

HANDS ON
by Edward Mendelson

Don't be fooled by appearances. *Textra* is a high-end powerhouse of a word processor cleverly disguised as a modest package that costs a mere $95. With the new version, 6.0, Ann Arbor Software's DOS-based word processor has grown from small beginnings to the point where it rivals or exceeds the speed, features, and convenience of programs that cost five times as much.

Textra offers the best features of most full-price packages, with none of their worst features. If you want automatic, transparent importing from major word processing formats, you don't have to endure *MultiMate* to get it. *Textra* does the job faster and easier—and can even save your files in any of the formats it imports. If you want to install any LaserJet or PostScript soft font without waiting for a new driver from your software vendor, you don't have to buy *WordStar* and use its configuration utility. *Textra* imports bitmap or scalable fonts, uses them in its accurate page preview, and does the whole job automatically from inside the program itself. *Textra* supports over 1,000 characters and symbols, and automatically recognizes their presence in LaserJet font files.

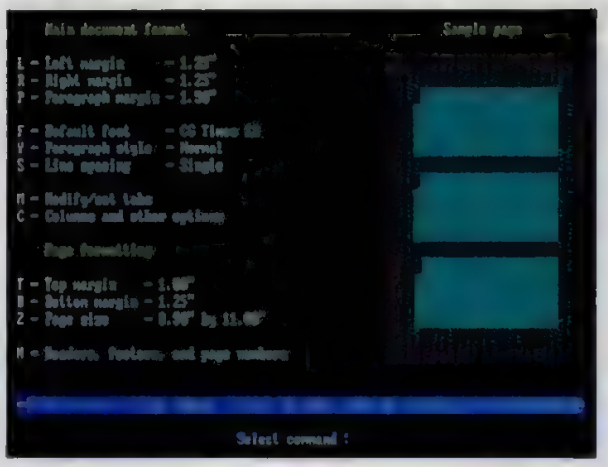
Textra and *Microsoft Word* are the only DOS-based word processors that let you edit two or more sections of the same file in different windows, with the changes you make in one window automatically appearing in the others. Like *Word*, *Textra* lets you edit up to eight files at once in windows or full-screen mode. Also like *Word*, *Textra* paginates in the background, but does it much faster than *Word* can.

When you first install *Textra*, the screen displays a function-key menu at the foot and a status line and ruler at the top. The program uses all shift states of the function keys, but you don't need to bother pressing the Alt or Ctrl keys, because you can make the menu cycle through all four states, and you can simply press the unshifted F-keys that match the menu currently displayed. You can also remap the keyboard and attach functions (like sentence delete) that aren't in the default keyboard.

Once you become expert in the function-key interface, you can remove all menus and status lines and use the full screen for editing. *Textra* directly supports high-resolution video modes, so you can edit all the text that your video board can squeeze on to your screen. Only *Word* and *Nota Bene* can match *Textra*'s ability to display your text either with the line breaks you'll get on the page or with lines broken to fit on the screen.

Textra's page preview is faster and cleaner than anything else on the market. Unlike all other page previews, it doesn't rewrite the screen when you scroll down a page, but uses the VGA's smooth panning to move the image. You can access the page layout menu from the preview screen for quick experimentation with margins, columns, fonts, and tabs.

If you're not satisfied with all this, *Textra* offers rare and thoughtful conveniences like wildcards in both search and replace strings, a menu that lets you select from the last ten documents you edited (*Word for Windows*, with a similar feature, only displays the last four), dictionary-based hyphenation, spelling dictionaries that you can edit and replace, an editable print queue, and reverse-order printing so that you don't have to reshuffle pages when you use an early-model LaserJet or DeskJet. You get graphics import of PCX, TIFF, and EPS file formats, with control over borders, scaling, contrast, and brightness.



Textra's page layout screen lets you preview your layout before you select it.

Textra automatically compiles bibliographies, and its help screens display the proper form for punctuation and other style features. You also get a built-in address book that can import *dBASE* files and print envelopes, plus an option to browse through spreadsheets so you can directly mark the range you want to import. Unlike most inexpensive packages, *Textra* gives you stylesheets, editable macros, bookmarks, a thesaurus, nonprinting comments, dictionary hyphenation, keyboard speed control, and a phone dialer.

Although *Textra* is infinitely better than anything you ever expected from a $95 package, it has some flaws and rough edges. Its most serious fault is its limited Undelete function, which is available only until you type another character—after which your deletion is gone forever. The program supports endnotes, but not footnotes, lists, or tables of contents.

Textra's interface is simple but sometimes awkward. You can't scroll through lists of files or fonts line by line, but have to press PgDn or PgUp to see the next part of the list—which means you often can't see related items on-screen at the same time. You choose fonts from menus that make you press an arbitrary letter rather than letting you move a highlight or type the first letters of a name. You can use scalable fonts, but you have to preselect the sizes you intend to use. You can only have 20 font or size selections active at one time.

You can argue over whether you prefer (as in most recent programs) to mark a block then decide whether to copy it or move it, or (as in *Textra*) to select the copy or move functions and then mark the block. You can argue over whether you prefer the function-key interface of *Textra* and *WordPerfect* to menu-driven programs like *Word*. But there's no argument over *Textra*'s unique combination of power, flexibility, and value. It's a terrific $500 program that happens to cost a fraction of that amount. ■

FACT FILE

Textra 6.0
Ann Arbor Software, 345 South Division, Ann Arbor, MI 48104; 313-769-9088.
List Price: $95.
Requires: 384K RAM, DOS 2.0 or later.
In Short: A high-powered word processor at a bargain price. *Textra*'s convenient and often brilliantly thought-out features make it one of the few programs in its field worth considering.

CIRCLE 709 ON READER SERVICE CARD

The 11" x 17" PostScript Powerhouse Just $9995!

PC MAGAZINE EDITORS' CHOICE November 13, 1990 QMS PS 2210

POSTSCRIPT™

Features That Make The QMS-PS 2210 A True PostScript Powerhouse!

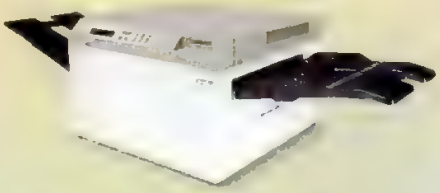
- Up to 11"x17" printing capability
- 22 pages per minute and QMS ASAP technology cuts waiting time
- 4 MB RAM builds complex pages quickly
- 39 resident Adobe PostScript typefaces
- HP LaserJet & HP-GL emulations for non-PostScript applications
- AppleTalk, RS-232 serial and Centronics parallel interfaces mean instant connectivity in practically all environments
- Choice of 350 or 600 sheet input capacity
- SCSI port allows connection of up to seven external hard drives for font caching and permanent storage of downloadable typefaces, emulations and PostScript programs
- PS Executive Series™ utility software allows each user to name, configure and align the printer as well as download fonts from the individual host computer

22 Pages Per Minute Give It The Best Price-To-Performance Ratio On The Market

It took QMS® to engineer a 22 page-per-minute PostScript® laser printer that stretches beyond the capabilities of other printers and *still costs less!* The QMS-PS® 2210 reaches beyond many others by giving you all popular paper sizes up to 11" x 17"/A3-size printing capability. And it surpasses others in print quality as well with laser-sharp fine line detail and rich saturated black fill areas. No more pale cut-and-paste newsletters, no more mismatched spread sheets, no more engineering and design projects held together with staples and tape! And the 2210 beats the competition price-wise, too, by delivering all this and more for just $9995.

Perfect For The "Upscale" Network

The QMS-PS 2210 is perfect for a shared printer environment requiring high-quality 11"x17" output. Whether you use Macintosh® computers, IBM®PC's /compatibles or most other mini computers and mainframes, you'll enjoy instant connectivity with AppleTalk®, RS-232 serial and Centronics® parallel interfaces. Should you require non-PostScript printing applications, the 2210 comes standard



with HP-GL® and HP® LaserJet® emulations. The 2210 also cuts waiting time with fast page processing made possible by QMS's exclusive ASAP™ (Advanced System Architecture for PostScript) technology and a 68020 microprocessor. That means fast first-page-out performance. Add this to 350 sheet input capacity (600 sheets in the QMS-PS 2220) plus a 20,000 page-per-month duty cycle, and it's easy to see why the QMS-PS 2210 is a true network star!

Expert Service And Support

As a recognized leader in PostScript printer technology, QMS maintains a commitment to customer satisfaction by providing free, responsive technical support. And to keep your QMS printer operating at its peak, QMS National Service offers a variety of service options. Call us today and see how easy it is to put the true PostScript powerhouse to work for you. Or FAX QMS Product Information at **(205) 633-4866.**

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CIRCLE 141 ON READER SERVICE CARD

$995 Developer's Tool Speeds Creation of Windows Interfaces

HANDS ON
by Richard Hale Shaw

Windows programming is a tough nut to crack, but Blue Sky Software's *WindowsMAKER Professional (WMPro)* 3.10 is a capable nutcracker.

It allows developers to prototype, animate, and test their *Windows* applications in a complete WYSIWYG environment. The $995 program will not generate your entire application, but it *will* do most of the laborious work of building your *Windows* interface.

Unlike the previous version (now the $395 *WindowsMAKER* 3.02), the *Professional* version preserves changes made to source files. In addition, *WMPro* packs a considerably greater punch by including a simulation mode that offers on-the-fly modifications; support for additional *Windows* C and C++ compilers; an improved dialog editor; and a powerful new facility for integrating your other *Windows* tools.

In order to create an application with *WMPro*, you prototype the application interface, windows, menus, and dialog boxes. Then you test the interface code, and finally, use *WMPro* to generate the source code. Ultimately, the program generates a skeleton application along with the requisite code to re-create the interface.

Creating the interface is easy: By pointing and clicking you set window colors, cursors, and styles, select icons, and create menus, dialog boxes, and child windows. When you begin, *WMPro* places a menu icon on the menu bar of your new application window. Click on the icon and a dialog lets you add menus. (A list box enables you to choose from over 40 predefined menu names.)

A pop-up bitmap viewer/selector makes using bitmaps in place of menu items easy (a few predefined bitmaps are provided, but you can use any .BMP file). Menu items can be rearranged, cut and pasted into different positions, or have cascading menus attached.

Menus can also have attached actions such as running user-defined code, external programs, existing functions, or activating a dialog box. To create a dialog from scratch you can invoke the dialog editor or copy and paste dialogs from existing applications. Both options are considerably easier than editing the switch statement the traditional way.

While *WMPro*'s dialog editor is more powerful and easier to use than the one found in *Microsoft Windows SDK*, it lacks the intuitive feel and ease of editors like the Whitewater Group's *Resource Toolkit*. While you can group dialog controls to space them or align them, you often have to go through several steps to do so; with the *Resource Toolkit* there's only one step.

The program's most powerful feature is its animation test mode. Like other programs such as *CASE:W*, you can enter test mode and run the application interface under *Windows* without generating any source code. But unlike *CASE:W*, everything in the interface remains soft: You can double-click on a control, menu, or dialog and begin modifying it immediately. This means you can design a complete application interface, let end users test-drive it, and modify the interface while they watch—all of this without generating a line of source code.

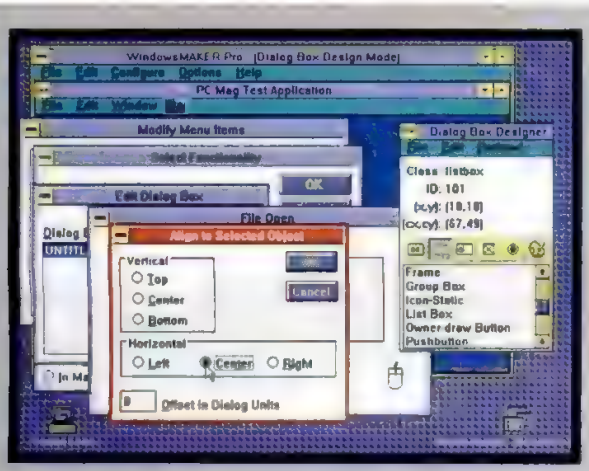
If its animation test mode is *WMPro*'s most powerful feature, then QuickMENU, its tool integrator, is the most impressive. QuickMENU is installed via WIN.INI so you can deinstall it if you wish. It adds a "hot" bitmap of Blue Sky's logo to the title bar in the currently active window on your *Windows* desktop. When you click the bitmap, it displays a menu of entries containing the standard *Windows* mini apps, *WMPro* and its utilities, and some of the tools in the *Windows SDK*. The menu is completely configurable so you can add your own entries.

As you activate other *Windows* applications, the QuickMENU icon follows you around attaching its icon to the title bar of each, making QuickMENU more convenient than Program Manager for accessing frequently used programs.

It's still up to you to write the noninterface code for your *Windows* application. *WMPro* uses code modules to separate the functions it supplies from the skeleton .C files and your own code; it preserves changes you make to the .C files when you regenerate the application after changing the interface code. When you're ready to test your noninterface code, you need to invoke the C compiler—which you can do from one of the *WMPro* menu options.

Unfortunately, *WMPro*'s generated source code uses the older, pre-ANSI function definition styles, with separate function argument and function type lists. And while the supplied comments are appreciated, there's no support for generating single-line comments (as allowed by ANSI and found in C++). *WMPro* can support *Windows* compilers like Borland C++ and Zortech C++, but there is no configuration dialog available for using them.

Nevertheless, *WMPro* is accommodating. The interface is natural and intuitive, and the time you'll save will outweigh any annoyances. ■



WindowsMAKER Pro's tools create most of a Windows application's interface, including menus, icons, colors, bitmaps, and dialog boxes.

FACT FILE

***WindowsMAKER Professional* 3.10**
Blue Sky Software Corp., 2375 E. Tropicana Ave., #320, Las Vegas, NV 89119; 800-677-4946.
List Price: $995.
Requires: DOS 3.1 or later, *Windows* 3.0 or later, and either Microsoft C 5.1 or later, Zortech C++ Developer's Edition 2.1 or later, or Borland C++ 2.0 or later. *Microsoft Windows SDK* 3.0 or later required when using the Microsoft or Zortech compilers.
In Short: A tool for developing *Windows* interface code, *WMPro*'s animation test facilities, on-the-fly editing, QuickMENU, and dialog editor are top-notch, despite annoying source-code generation habits.

CIRCLE 430 ON READER SERVICE CARD

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INTRODUCING GATEWAY'S

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The Gateway 2000 286 system operates at 16 MHz, rather than 12 MHz, for better performance. Our 386SX is available as a 16 MHz or a 20 MHz system. The 386SX-20 includes a 32K cache, which makes this system another truly outstanding Gateway price/performer.

BETTER-THAN-EVER VALUE

Possibly the most dramatic news about our new mini desktop systems is their prices. When a manufacturer introduces a new product line, you expect to see an eruption of price hikes. But then you've come to know Gateway is not like most manufacturers. Prices on systems in our new line are better than ever. And that goes for quality and service too, making the hottest value in the industry even hotter.

LITTLE SPITFIRE SYSTEMS

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INTRODUCING GATEWAY'S FI

HOT-PERFORMANCE 386 AND 486 SYSTEMS ARE IN ICY GRAY, CURVILINEAR MODELS

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Gateway's product development team is constantly searching the market for the highest performance, most reliable components. When we found a very reliable line of IDE (Integrated Drive Electronics) hard drives, the switch from ESDI drives was obvious. All models of the IDE drive include a built-in cache, making this one of the fastest drives on the market (as fast as 15ms access time, 10 Mb/second DTR).

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All across our product line, we've incorporated ASICs in the design of our motherboards whenever the change improved cost/performance. ASICs make boards more reliable with less RF emissions.

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When our 25 MHz 486 dropped below $4,000, it was the hottest value going in high-end technology. Now Gateway's new 33 MHz 486 – fully loaded – is priced at $3,995! You'd be hard pressed to find a loaded 386 for this price anywhere else. With either 486 system, you get Intel's 486 processor with built-in math co-processor and 8K cache.

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8 0 0 5 2 3 2 0 0 0

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In redesigning our new product line, we paid special attention to the things you use most: the keyboard and monitor. When you work with a personal computer for hours every day, you need a keyboard that feels good and makes your input tasks as easy as possible. And you need a monitor that's comfortable to look at. Our new AnyKey keyboard and Crystal Scan 1024NI monitor will give you exactly what you need.

THE PROGRAMMABLE ANYKEY

We call it the AnyKey because any key can be programmed to perform any function – anything you can imagine, quickly and easily. It's a revolutionary new concept designed to let you talk to your personal computer in a very personal way. Boilerplate information of all kinds can be easily assigned to any key and typed into any document with a single keystroke. Or you can remap the keys to create your own keyboard layout.

EXTRA KEYS, EXTRA VERSATILITY

The AnyKey includes a numeric pad and a separate, full-function cursor pad with diagonal keys, plus two sets of function keys located along the top and left side. Other features include an unshifted asterisk, two backslash keys, an adjustable repeat rate and a software tutorial.

EASY TO LEARN

The Anykey's versatility is rivaled only by its simplicity. You can learn to program it in just a few minutes. If you goof, you can easily reset the keyboard to a normal configuration. And if you hate the idea of programming anything, you'll still love the feel and extra keys on the AnyKey. Use it just the way it comes out of the box. The AnyKey keyboard is an option with all Gateway 2000 computer systems.

Peripherals, including the AnyKey and Crystal Scan 1024NI, are sold only with Gateway 2000 systems. Sorry –we cannot sell peripherals separately.

KEY™ & CRYSTAL SCAN 1024NI

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From most manufacturers, a 1024 x 768 VGA color monitor is an expensive option. From Gateway 2000, 1024 x 768 color monitors have been standard for a long time. And now, the Crystal Scan 1024NI, a non-interlaced 1024 x 768 color monitor, is standard with all 386 and 486 systems.

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LOOKING AHEAD

The introduction of our new product line represents almost a year of design and engineering. But it's just one phase in a process of continuous improvement that we employ at Gateway. Each day, Gateway 2000 employees come to work with one primary goal in mind: to provide you with better prices, performance, quality and service. We're committed to making Gateway 2000 the only logical choice in microcomputers.

We'd like to thank our customers for their valuable contributions to the redesign of our product line. It was our customers' suggestions and comments that gave us our direction. And to all the Gateway folks who began to think the 18-hour work day was normal, here's a public pat-on-the-back. Thanks for your continuing dedication.

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- 1 Parallel/2 Serial Ports
- 1 PS/2 Mouse Port
- 101 Key Keyboard
- MS DOS™ 3.3 or 4.01

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- MS DOS 3.3 or 4.01
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- 200 MB 15ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- Microsoft Mouse
- MS DOS 3.3 or 4.01
- MS Windows 3.0

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33MHZ 486 CACHE

- Intel 80486 Processor with Co-Pro and 8K Internal Cache
- 64K Cache RAM
- 8 MB RAM, Expands to 64 MB
- 1.2 MB 5.25" Drive
- 1.44 MB 3.5" Drive
- 200 MB 17ms IDE Drive with 64K Multi-Segmented Cache
- 16-Bit VGA with 1 MB
- 14" Crystal Scan 1024NI Color VGA Monitor
- 1 Parallel/2 Serial Ports
- 101 Key Keyboard
- Microsoft Mouse
- MS DOS 3.3 or 4.01
- MS Windows 3.0

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Pocket Modem Choices Range From State of the Art to No-Frills

Hayes Pocket Edition 2400

HANDS ON by Christopher Barr

Hayes' Pocket Edition 2400, a pocket-sized 2,400-bps external modem, isn't exactly state of the art when it comes to its feature set, nor is it early to the pocket modem market.

The 3-ounce, $179 modem's greatest selling point is also its greatest drawback: It doesn't require batteries. The modem draws power from the serial port and the telephone line.

The power drain on a laptop battery is minimal; only the AT commands sent to the modem use serial port power. All other modem functions are powered from the RJ-11 jack; one drawback of that arrangement is that you can't use an acoustic coupler with it and, occasionally, you'll run into a digital network that may not supply enough power to make a connection.

The Pocket Edition has no speaker so you can't tell if you've made a connection. It doesn't have indicator lights. And there's no built-in data compression or error control.

Everything about the Pocket Edition 2400 is compact. It's slightly smaller than a deck of playing cards, it doesn't require an external serial cable, and there are no DIP switches.

A 10-inch cable with a 9-pin serial connector and a 6-foot telephone cord with an RJ-11 plug are permanently attached to the unit.

The Pocket Edition uses a subset of the Hayes Smartmodem 2400 AT command set, which makes it, as you might imagine, genuinely "Hayes-compatible." It can store two different configuration settings and up to four telephone numbers in nonvolatile memory.

Hayes bundles *Smartcom EZ*, a subset of Hayes' full-featured *Smartcom Exec*. A stripped-down program, *Smartcom EZ* is limited to VT102 emulation and Xmodem as its only error-free file-transfer protocol. The lack of a scripting language makes it even more bare-bones. But you can use any communications software that recognizes the Hayes Smartmodem 2400 AT command set.

If all you require is convenient access to e-mail, and you'll always be calling on a conventional analog line, the Pocket Edition 2400 can save a fortune in batteries. ■

List Price: Pocket Edition 2400, $179. **Requires:** 9-pin RS-232 serial port, RJ-11 jack. Hayes Microcomputer Products Inc., P.O. Box 105203, Atlanta, GA 30348; 404-449-8791.

CIRCLE 431 ON READER SERVICE CARD

The $179 Pocket Edition 2400 from Hayes needs no batteries and offers no frills.

WorldPort 9600

HANDS ON by M. David Stone

When it comes to computer equipment, the term "portable" is often synonymous with "compromise." Not so with the WorldPort 9600, a 9,600-bit-per-second modem from Touchbase Systems.

Priced at a hefty $899, the WorldPort 9600 measures just 1 by 4.9 by 2.75 inches (HWD)—making it just slightly thicker than an audio cassette tape.

Touchbase packs a lot of modem into this less than half-pound package, including a speaker.

In addition to V.32 compatibility at 9,600 and 4,800 bps, the modem offers compatibility at 2,400 bps with the V.22bis standard, at 1,200 bps with both the U.S. Bell 212 and the European V.22 standards, and at 300 bps with both U.S. Bell 103 and European V.21 standards. It's even compatible with V.23, an older European standard.

Error control, which is a useful luxury at 2,400 bps, is a virtual necessity at higher speeds. So it's not surprising that the WorldPort 9600 also includes MNP 2 through MNP 4. In our tests, the modem had no problem establishing an MNP 4 link with a Hayes Ultra 96 at either 9,600 bps or 2,400 bps.

One trick missing from the modem itself is data compression. However, MagicSoft's *MTEZ* program, which comes with the modem, supplies MNP 5 data compression in the software. Such software-based compression tends to be less efficient than hardware-based compression, but it still yields faster file transfers than having none at all.

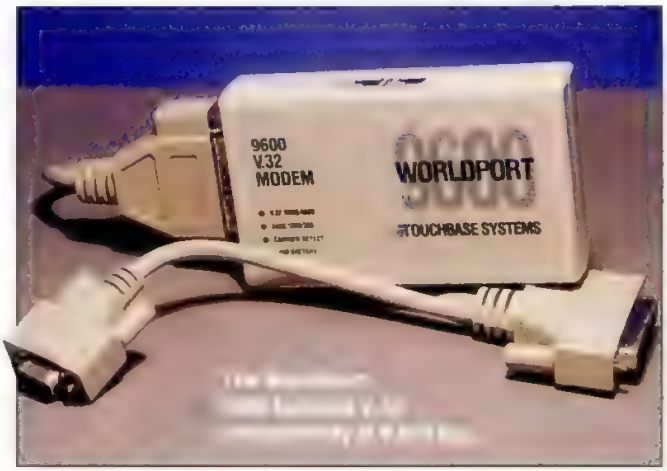
During testing we used the modem with *MTEZ* and had no problems establishing an MNP 5 link with the Ultra 96. And, even though many V.42bis modems offer MNP 5, it is not part of the V.42bis data-compression standard.

If you already have a favorite communications program, the WorldPort will likely work with it. The only exceptions may be programs written exclusively for the Hayes modem.

The WorldPort 9600 has indicator lights for speed, carrier detect, and low battery light—more than you'll find on most portable modems. While that's not a complete set of status lights, the missing ones are a small price to pay for 9,600 bps in such a tiny package. ■

List Price: WorldPort 9600, $899. **Requires:** Serial port. Touchbase Systems Inc., 160 Laurel Ave., Northport, NY 11768; 800-541-0345, 516-261-0423.

CIRCLE 704 ON READER SERVICE CARD



TrueVision's VideoVGA Overlays PC Images on Video and S-Video

HANDS ON
by John R. Quain

The $995 VideoVGA from TrueVision is a video adapter board that serves a dual purpose. It generates standard VGA output, but it can also superimpose computer graphics over television-style video.

The VideoVGA videographics adapter combines a VGA adapter with resolution at Super VGA modes up to 1,024-by-768 with a full-motion NTSC (National Television Systems Committee) overlay board in an ISA, full-length 16-bit adapter card.

The VideoVGA is designed as a straightforward solution for those who want to combine PC and video images and have the option of either displaying them on an interlaced (television-style) monitor or recording them on videotape.

The board has no audio capabilities and, unlike TrueVision's Targa+ series, which costs from $1,795 to $2,495, it has no frame buffering, so it's not meant to capture and manipulate images.

The VideoVGA card accepts a standard video feed from a camcorder, VCR, or laser disk player, and overlays the computer's VGA graphics onto NTSC video by replacing one of the graphic's potential 256 colors (selectable from a palette of 262,144) with the composite video material. The card also genlocks or synchronizes the VGA signal to the timing of the standard NTSC signal.

TrueVision's VideoVGA can be used as a traditional VGA card, but it also has the capability to superimpose computer graphics over a video image.

For display of ordinary VGA video output on a computer monitor, VideoVGA, in its basic 512K RAM configuration, runs the standard VGA modes plus 800-by-600 noninterlaced Super VGA. When 1MB RAM is installed, the board can output 1,024-by-768 in 256 colors.

Even with the added memory, the highest resolution for overlay or recording is still 640-by-480 pixels with 256 colors because of limitations in the NTSC standard. And although the board can simultaneously display VGA and NTSC signals, the VideoVGA shows the overlay image only on the composite output used for driving a VCR or interlaced NTSC monitor, not on the VGA output used for driving the VGA monitor.

Controls for the VideoVGA's video capabilities are rudimentary but convenient. Overlay or key selection is performed via a software TSR that requires about 20K of RAM.

The TSR allows you to set underscan mode (size of the picture) and center the VGA image as well as toggle VGA-to-NTSC output on and off. There's also a utility for loading four supplied fonts and for creating new fonts, but its interface is stodgy and awkward. You can include graphics and text from other applications such as *Windows* 3.0, *AutoCAD*, and *Lotus 1-2-3* using drivers bundled with the system.

Genlocking is automatic: The card senses which composite video signal—S-Video or standard video—is active and genlocks the VGA signal to it.

Our tests showed that the genlock on the VideoVGA was unusually steady, exhibiting no appreciable flicker or rolling. The one problem we encountered was when genlocking to a video signal from a VCR in pause mode; the computer graphic rolled while the video image held still, indicating that the video timing of the signal from the VCR was outside the VideoVGA's genlock range.

The board has two RCA jacks for composite video input and output, a single 6-pin DIN jack for S-Video input and output (cable supplied), and a mini DB-15 connector for a computer monitor.

The VideoVGA uses the respected Tseng Laboratories ET4000 chip set. Its performance is comparable with other Tseng-based boards, and it had no trouble with the PC Magazine Labs VGA benchmark tests. Furthermore, Targa users will appreciate the card's VGA feature connector, which can be used to hook up the VideoVGA to a Targa+ board.

Compared with similarly priced products such as Willow Peripherals' VGA TV GE/O and USVideo's TVGA/Genlock Overlay, the VideoVGA board offers more colors, and S-Video input and output. Its genlocking appears to be superior.

If you're editing video using a PC and an S-Video source or target, the VideoVGA adapter board is a good buy. ■

List Price: VideoVGA, with 512K DRAM, $995; with 1MB DRAM, $1,195. **Requires:** 8-bit or 16-bit ISA slot, 640K RAM, and DOS 3.1 or later.
TrueVision, 7340 Shadeland Station, Indianapolis, IN 46256; 317-841-0332.
In Short: A Super VGA board that genlocks to NTSC and S-Video signals, allowing the creation of videos that include PC graphics.

CIRCLE 700 ON READER SERVICE CARD

VideoVGA VERSUS THE COMPETITION

A comparison of some of the leading VGA-compatible video overlay boards shows that TrueVision's new VideoVGA is the only one offering S-Video input and output.

	Price	Maximum VGA mode	Video inputs	VGA chip set
TrueVision VideoVGA	$995	1,024 x 768, 256 colors	NTSC composite in/out, S-Video in/out	Tseng 4000
USVideo TVGA/Genlock	$1,199	1,024 x 768, 256 colors	NTSC composite in/out	Trident
Willow VGA TV GE/O	$895	1,024 x 768, 16 colors	NTSC composite in/out, S-Video out	Tseng 3000

Quick, name the world's best memory manager:

NETROOM!

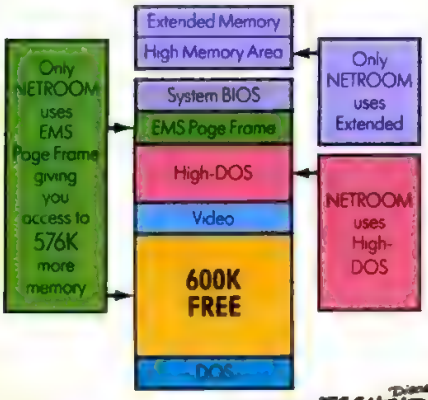
Right!

PC MAGAZINE EDITORS' CHOICE Jan. 29, 1991

If you thought the answer is QEMM® or 386MAX®, think again. Because **NETROOM®** just beat them both, by winning PC Magazine's prestigious Editors' Choice award.

PC Magazine said† *"With its versatility, this $149 four-user version rates as a real winner. Considering NETROOM's price and capabilities, you will find that there is no second choice."*

What makes **NETROOM** a winner is that it is more than a great LAN manager. It is a full-featured memory manager that not only relocates LANs (like Novell, VINES®, etc.), it also moves device drivers, and TSRs into extended, expanded, and high-DOS memory.



Features:	NET-ROOM	QEMM	386 MAX
Windows 3.0 support	✔	✔	✔
Multiuser license	✔		
Converts Ext. to Exp. †	✔	✔	✔
Relocates to High-DOS	✔	✔	✔
Relocates to LIM 3.2 Frame	✔		
Relocates to Expanded	✔		
Relocates to Extended	✔		
Works on 386/486	✔	✔	✔
Works on 8088/286	✔		
Memory Analysis Utility	✔		

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PC Magazine says *"Netroom's $149 price for four users is a steal."* So, go out and steal yourself a copy!

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Requirements: A 386, or some EMS 3.2 or EMS 4.0 memory hardware, or at least 64K ext. memory and DOS 3.3 or greater

†This feature not available on 286 machines.

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$130 Pinboard Maintains a Public Message Center

HANDS ON
by Barry Simon

Bulletin boards—the old-fashioned kind where you pin notes on a corkboard—still have an important role in keeping offices running smoothly.

Now *Windows* has its own electronic version of this simple communications tool. *Pinboard* by Raindrop Software, a $129.95 *Windows* 3.0 utility, is a simple electronic tack board where you can post messages.

The program loads a large nonresizable window that actually looks like a corkboard. Using thumbtack and notepad icons, you create messages that are posted on the board.

A note is created by grabbing a tack from the leftmost column of the screen and dragging a copy of it onto the messaging board. Double-clicking on it brings up a dialog box where you can enter or edit text or change the bitmap template. The program remembers the last bitmap for each color tack, so you can color-code your frequent message topics. You can also use the message center to launch an application, since you can assign an executable program to a note.

A network version of *Pinboard* allows the creation of shared as well as private boards. You can access multiple boards and display active notes from a single private board and a single shared board simultaneously. Private and shared notes are distinguished by the size of the tacks they use.

Pinboard bears some resemblance to *InfoSelect* (originally called *Tornado Notes*). *Pinboard*'s network hooks, graphics templates, and ability to execute programs give it some extra power, but *InfoSelect*'s organizational, display, and search tools are superior.

Pinboard represents an innovative concept that could prove to be a very powerful tool—especially if it is developed further in later versions. ■

***Pinboard* lets you run a desktop message center for shared and personal messages. It also supplies note templates and a built-in editor.**

List Price: *Pinboard*, Version 3.0, $129.95. Network extender packs: 5 users, $399; 10 users, $699; 25 users, $1,495.
Requires: *Windows* 3.0, mouse.
Raindrop Software, 845 Arapaho Rd., #105, Richardson, TX 75081; 214-234-2611.

CIRCLE 432 ON READER SERVICE CARD

CorelDRIVER Uses NLMs To Make CD-ROM Sharing Easier

HANDS ON
by Sara Parker

Normally, sharing a CD-ROM on the network involves attaching the CD-ROM drives to a dedicated machine and running third-party resource-sharing software. A DOS redirector provides access to the drives.

CorelDRIVER takes a different approach.

To use *CorelDRIVER*, you install a SCSI adapter board in the *NetWare 386* file server and load a series of NLMs (*NetWare* Loadable Modules) on the network. Locally, you install a device driver and Microsoft's CD-ROM extensions. The workstation then accesses the CD across the network through its drivers.

On the workstation, the menu-driven installation process automatically adds a line to your CONFIG.SYS file, adding a device driver. Users map DOS drive letters directly to the optical volumes or sets of CD-ROMs (databases).

Corel Systems Corp.'s package includes interface software and drivers for *NetWare 386*, a SCSI interface card, a SCSI interface cable, and a user manual. NLMs for *NetWare 386*, Version 3.11, are being developed, but currently only Version 3.10 is supported.

From the network's point of view, CD-ROMs are not mountable drives. Corel bypasses this limitation by including the CDSRV NLM utility, which allows you to add one or more CD-ROMs on the file server to create what Corel terms a database. Multiple CD-ROMs can be assigned to a database and then mounted or dismounted as a set. Databases are also created, edited, and deleted through the CDSRV utility.

Corel also includes two other helpful utilities. CDCON assigns access to the CD-ROM server by user or by group. CDMAP allows network management of the CD-ROM drives, and is used to connect the server CD-ROM to the client PC.

CorelDRIVER is fully compatible with most SCSI CD-ROMs from major manufacturers, including Pioneer, Sony, NEC, Panasonic, Toshiba, Hitachi, LMSI, and Texel. We tested the product with a Sony CD-ROM and found *CorelDRIVER* to be stable, fast, and easy to implement.

Accessing the CD-ROM on the network was four times as fast as accessing it on a standalone machine, even without any buffering turned on in Microsoft's CD extensions. The speedy performance is primarily because Corel takes advantage of *NetWare*'s disk caching in the server.

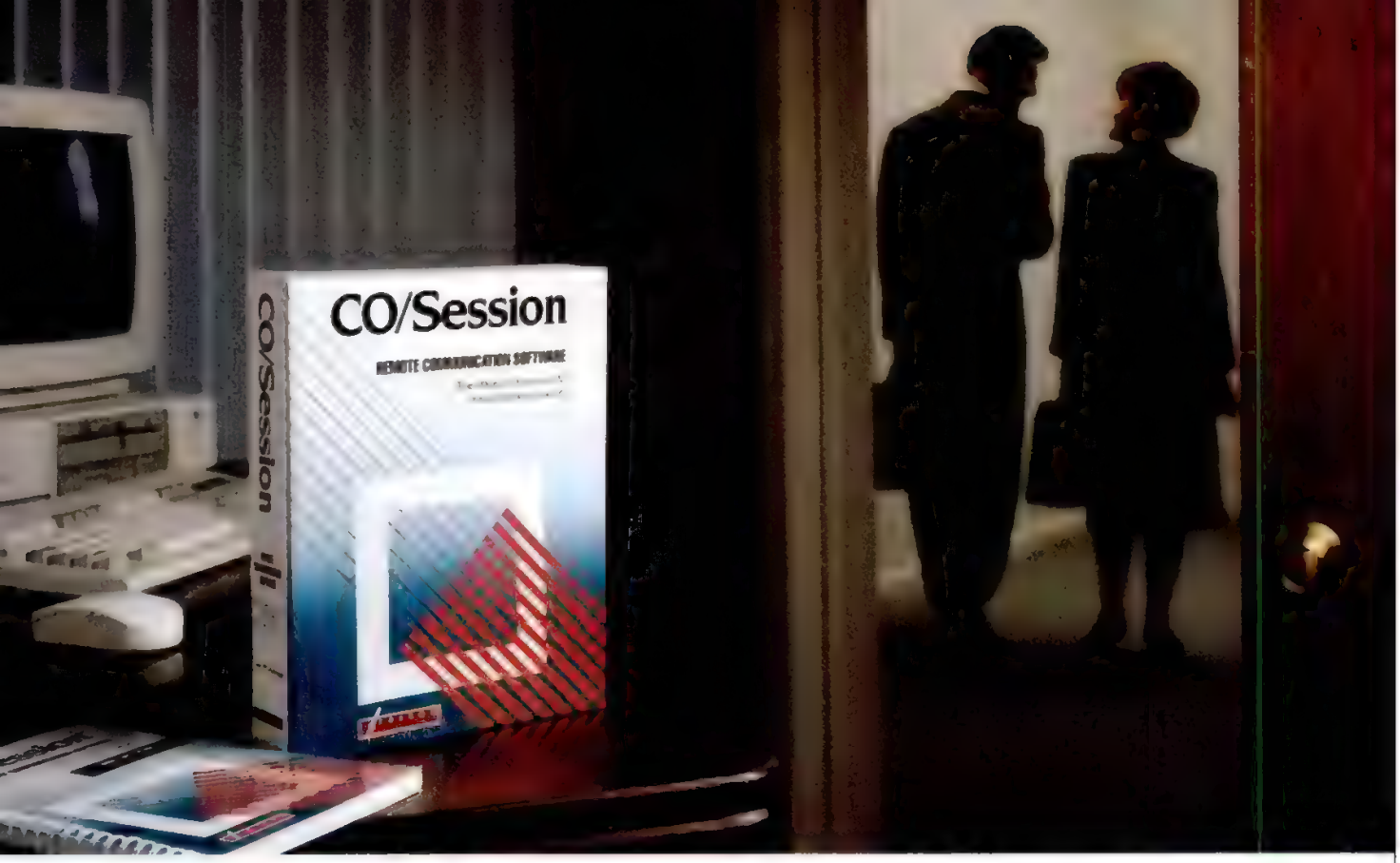
The first query you make must access the CD-ROM disk, so it won't be quite as fast as subsequent searches. However, subsequent searches will often access the disk cache instead of the actual disk, speeding up search times.

The speedy performance of the cache commands its price. The cache memory allotted to each CD-ROM on the file server can be configured from 0 bytes on up; the default is 512K per drive, which means that hooking up two CD-ROMs requires a full megabyte of file server memory.

CorelDRIVER poses a solution to the problem of shared CD-ROM devices on the network. Those with well-endowed file servers will most appreciate its speed and cost benefits. ■

List Price: *CorelDRIVER*, 8-user interface kit for *NetWare 386*, $1,045; MCA version, $1,245; 100-user interface kit for *NetWare 386*, $1,995; MCA version, $2,195.
Requires: For file server: 386-based PC or better; 250K RAM; 40MB hard disk; *NetWare*, Version 3.1. For workstation: 43K RAM, DOS 3.3 or later.
Corel Systems Corp., 1600 Carling Ave., Ottawa, Ontario K1Z 8R7; 613-728-8200.

CIRCLE 701 ON READER SERVICE CARD



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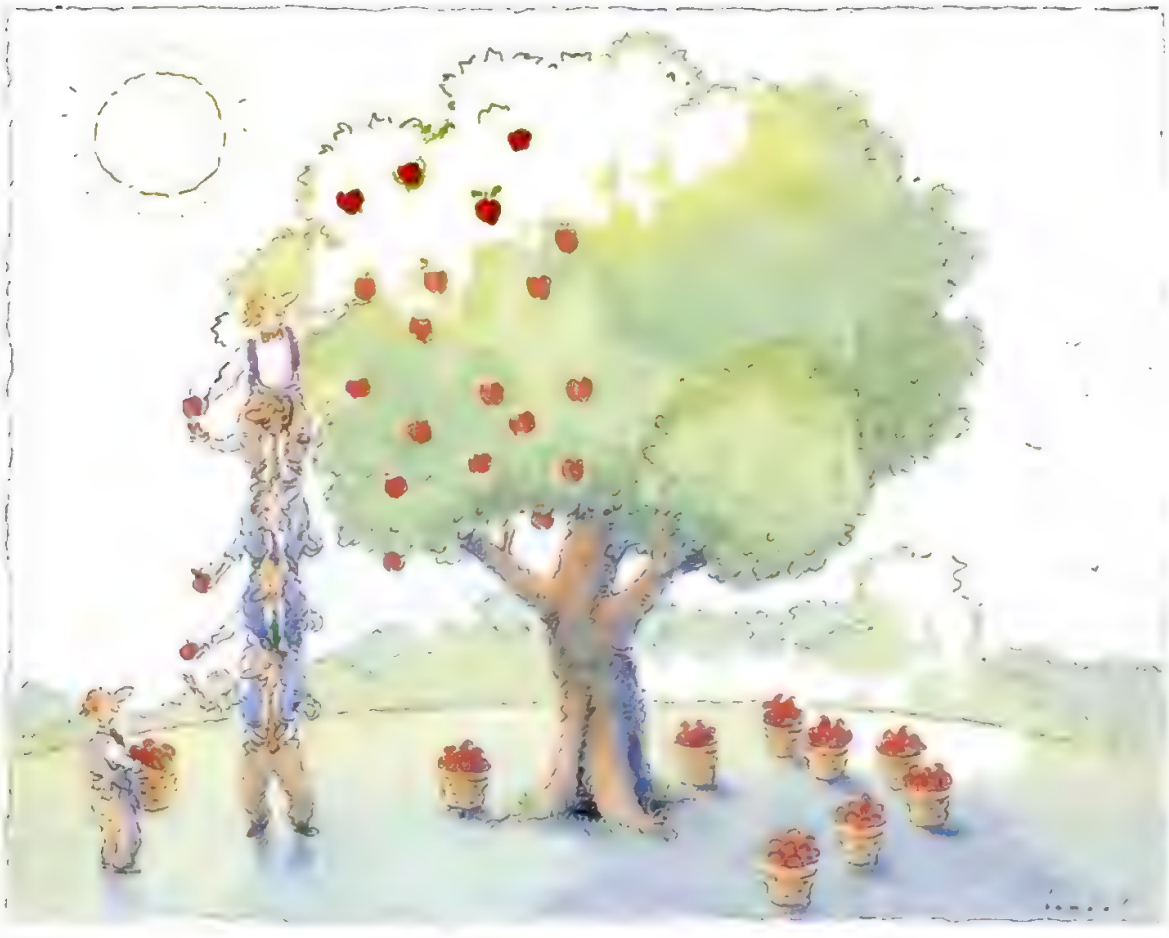
CIRCLE 191 ON READER SERVICE CARD



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CIRCLE 148 ON READER SERVICE CARD

by
Cristina Córdova
and Nate Zelnick

New & Improved

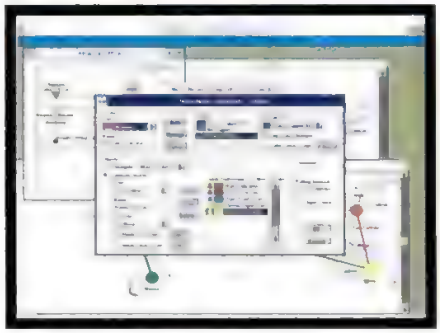
News of Announced Products and Upgrades

Visual Tool Monitors And Maps Network Activity in Windows

NEW **Technology Dynamics'** $1,995 *Windows* network monitoring system, *VisiNet Live*, displays a graphical representation of network information.

VisiNet Live's network map, comprised of hierarchical views, provides extensive network information. It automatically retrieves the network's status, attributes, and statistics for each node and link in user-definable fields, thus allowing the manager to customize the view of his network. Each network view may incorporate an appropriate background map of the world, country, state, or province. The program also lets you import CAD-based floor plans (in .DXF format) to illustrate network layouts.

A built-in scripting language lets network managers define specific alarm and state conditions, while searching and reporting functions help managers locate specific network elements and examine their attributes. A log review application allows examination of past network events and trouble tickets.



***VisiNet Live* quickly isolates faults by displaying the state and alarm severity of each node and link on the network map.**

The network diagnostic supports Microsoft *LAN Manager*, NetBIOS, and Novell *NetWare*. *VisiNet Live* also supports DDE to facilitate graphing, charting, and producing logs in other *Windows*-based applications.

List Price: *VisiNet Live*, $1,995. **Requires:** 2MB RAM, 3MB hard disk space, DOS 3.0 or later, *Windows* 3.0. Technology Dynamics Inc., 430 10th St. NW, #S-008, Atlanta, GA 30318; 404-874-0428.

CIRCLE 435 ON READER SERVICE CARD

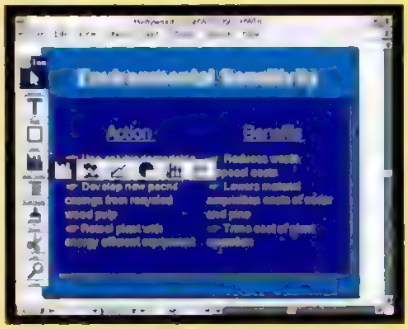
HOT PROSPECT

IBM'S HOLLYWOOD CREATES PRESENTATIONS FROM EITHER OUTLINE OR SPREADSHEET FORMATS

Hollywood, **IBM Desktop Software**'s new presentation graphics software, allows users to create high-quality hard copies, transparencies, slides, and on-screen presentations (a runtime version is included). The $495 package comes complete with an integrated outliner, professionally designed templates and color schemes, a master page facility for presentations, Bitstream's fully scalable Speedo fonts (from 6 to 360 points), screen-show capabilities, and charting, drawing, and painting tools.

Hollywood lets you enter text directly into the integrated outliner; you can also import ASCII, *WordPerfect*, and *DisplayWrite* files. The outliner can be used to organize a presentation, check spelling, and create bullet charts or organization charts.

To generate tables and charts, the data manager provides a spreadsheet-like interface where you can enter data or import it from *Lotus 1-2-3* or *Excel* spreadsheets.



IBM's *Hollywood* accepts most file formats.

List Price: *Hollywood*, $495. **Requires:** 1.6MB RAM, an IBM- or Microsoft-compatible mouse, DOS 3.3 or later, and *Windows* 3.02. IBM Desktop Software, 472 Wheelers Farms Rd., Milford, CT 06460; 800-IBM-7699, 203-783-7000.

CIRCLE 434 ON READER SERVICE CARD

Sharp Unveils Network And PostScript Printers

NEW Adding to its large line of PC peripherals, **Sharp Electronics Corp.** has begun shipping two new printers—a personal PostScript printer and a high-speed laser printer for workgroup environments. Both units incorporate Sharp's advanced laser and reprographic technology and come in an ultra-compact design.

The $3,195 JX-9500PS is a 6-page-per-minute PostScript laser printer with 300-dot-per-inch resolution, and 1.5MB of memory (upgradable to 4.5MB). In addition to the 35 scalable PostScript fonts, the JX-9500PS includes 14 HP-equivalent bitmapped fonts and accepts up to two font cards for additional choices. It uses Adobe's ATM font-rendering technology and emulates the HP LaserJet II (PCL 4) for software compatibility.

Best suited for the high-volume demands of busy workgroup environments, the JX-9700 laser printer offers output speeds of 16 pages per minute. For $3,295, it comes standard with 1MB of memory that is upgradable to 5MB. The dual component system offers five built-in emulations, including HP LaserJet II, Epson FX-80, IBM Graphics Printer, IBM Proprinter, and Diablo 630.

Both printers come with a 16-character liquid crystal display. Other options include a 250-sheet paper cassette tray, a second high-capacity paper tray (either 250 or 500 sheets available in letter, legal, executive, invoice, A4, and B5 sizes), manual-feed bypass, an automatic envelope feeder (for mass mailings), and a straight pull path that prevents paper curling.

List Price: JX-9500PS, $3,195; JX-9700, $3,295. Sharp Electronics Corp., Sharp Plaza, P.O. Box C, Mahwah, NJ 07430-2135; 201-529-9600.

CIRCLE 436 ON READER SERVICE CARD

$195 Contact Manager For Laptop Computers

NEW **Diamond Data Management** has launched a contact management program for laptop and notebook PC users. The $195 *Diamond Prospector* offers a special video mode for hard-to-read laptop PC displays. The program also has a compact file structure for storing a large number of records since to-

CONTINUES ON PAGE 58

BRIEFS

FILE UTILITIES

GammaTech has announced a set of utilities for the OS/2 High Performance File System (HPFS). The $69 *HPFS Utility Package* contains an optimizer for HPFS volumes, file recovery, directory list utilities, and backup control options. 405-359-1219.

Cognitronix has released a file- and text-search utility for *Windows* 3.0. The $14.95 *Searcher* finds files based on user-defined criteria. It offers the same basic functionality as *The Norton Utilities'* File Search, Text Search, File Attributes, and File Size programs. 619-549-8955.

SCREEN UTILITIES

TechSmith Corp.'s *SnagIt* allows you to cut and paste *Windows* 3.0 screens into documents, and print program screens, windows, and icons. The $79 program features image sizing, gray scaling, color-to-monochrome conversion, color adjustment, and support for DDE (dynamic data exchange), as well as TIFF and .BMP file formats. 517-347-0800.

Sonera Technologies has developed a package of video display utilities that evaluates and optimizes the performance of video displays and adapters. *DisplayMate* contains 200 patterns to visually test displays and 100 diagnostic tests to evaluate video adapters. 800-932-6323, 908-747-6886.

PRINTERS

Oce Graphics USA has unveiled a true Adobe PostScript color printer with a full tabloid-plus print size. The Oce G5242-PS (from $14,000 to $17,000) allows you to proof two-page layouts, posters, and other designs at full scale. It comes with 1.5MB ROM, 8MB RAM, and 300-dots-per-inch color thermal wax-transfer technology. 415-964-7900.

QMS has introduced a new generation of its 8-page-per-minute PostScript printer family. The QMS-PS 815 ($4,995) and 825 ($5,995) printers include simultaneous interface operation, automatic emulation switching, and an expanded collection of resident typefaces. 205-633-4300.

CONTINUED FROM PAGE 57

day's laptop and notebook computers have limited capacity hard disk drives.

The program integrates operations such as call scheduling, mailing list and database management, word processing and note-taking, report generation, sales and prospect tracking, and label generation. *Diamond Prospector* performs automatic phone dialing and local/long-distance dialing when used with a modem; automatic city, state, and area code tracked by ZIP codes; and dated material tracking. Other features include a built-in word processor; one-key access to prospect notes, macros, search and sort facilities; and seven different high-speed lookups of prospects and to-do lists.

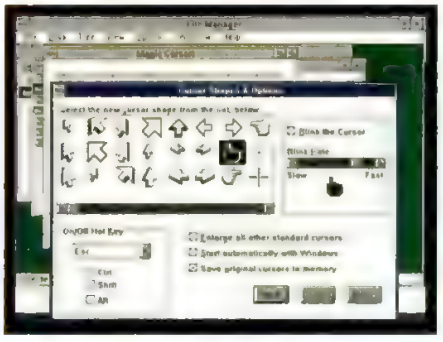
List Price: *Diamond Prospector*, $195.
Requires: 640K RAM, DOS 3.1 or later.
Diamond Data Management Inc., 740 Pilgrim Pkwy., Elm Grove, WI 53122; 414-786-9000.

CIRCLE 437 ON READER SERVICE CARD

$79 Utility Customizes Mouse and Cursors

NEW Two utilities from **Fanfare Software** let you customize your mouse cursor and create custom sets of mouse-button actions for each *Windows* application that you use.

Right On! lets you program special actions for the middle and right mouse button; you can simulate a left-button double-click, send any keystroke, or run any program. Using the mouse buttons in conjunction with the Shift, Ctrl, and Alt keys, you can program up to eight different actions for the right and middle mouse buttons. The $49.95 utility takes less then 10K of memory.



With *Magic Cursor!* you can change the shape and size of your mouse cursor.

For $79.95, *Magic Cursor!* lets users enlarge, customize, and even blink the standard mouse arrow cursor. It comes with 40 professionally designed cursors, including enlarged arrows (up to five times the standard size), cross hairs, hands, a pen or pencil, and a mouse. A special feature lets users automatically enlarge all of the other standard *Windows* cursors, such as those used when sizing a window. *Magic Cursor* also takes less than 10K of memory.

Both utilities can be turned on and off from any *Windows* application by a user-defined hotkey and can be loaded automatically when *Windows* is started.

List Price: *Right On!*, $49.95 (plus shipping); *Magic Cursor!*, $79.95 (plus shipping).
Requires: DOS 3.0 or later, *Windows* 3.0.
Fanfare Software, 9420 Reseda Blvd., #828, Northridge, CA 91324; 818-886-8787.

CIRCLE 438 ON READER SERVICE CARD

ATI Graphics Board Translates 24-Bit Images to 15-Bit

NEW ATI's VGA Wonder XL offers a low-cost solution for those who want to display 24-bit or 16-bit color images at 640-by-480 resolution. With 1MB of DRAM, the $399 video board displays 32,768 colors in 640-by-480 resolution and 256 colors in 1,024-by-768 or 800-by-600 resolution.

The VGA Wonder XL uses a custom color-blending technique, called Color Depth Enhancement, to adjust the pixel colors for the display of 24-bit true color images in 15-bit color. It also provides utilities to translate 24-bit Targa files to 15-bit file formats and back again. According to ATI, this allows users to edit Targa files on non-Targa systems.

The VGA Wonder XL supports VESA's 72-Hz refresh rate at all resolutions on both interlaced and noninterlaced monitors. It offers fast page-mode memory, optimized CPU/CRT memory interleave, and extended FIFOs. Furthermore, ATI packages the VGA Wonder XL with a Microsoft-compatible, three-button, 400-dpi mouse.

List Price: VGA Wonder XL, 256K, $299; 512K, $349; 1MB, $399. ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Canada M1W 3S2; 416-756-0781.

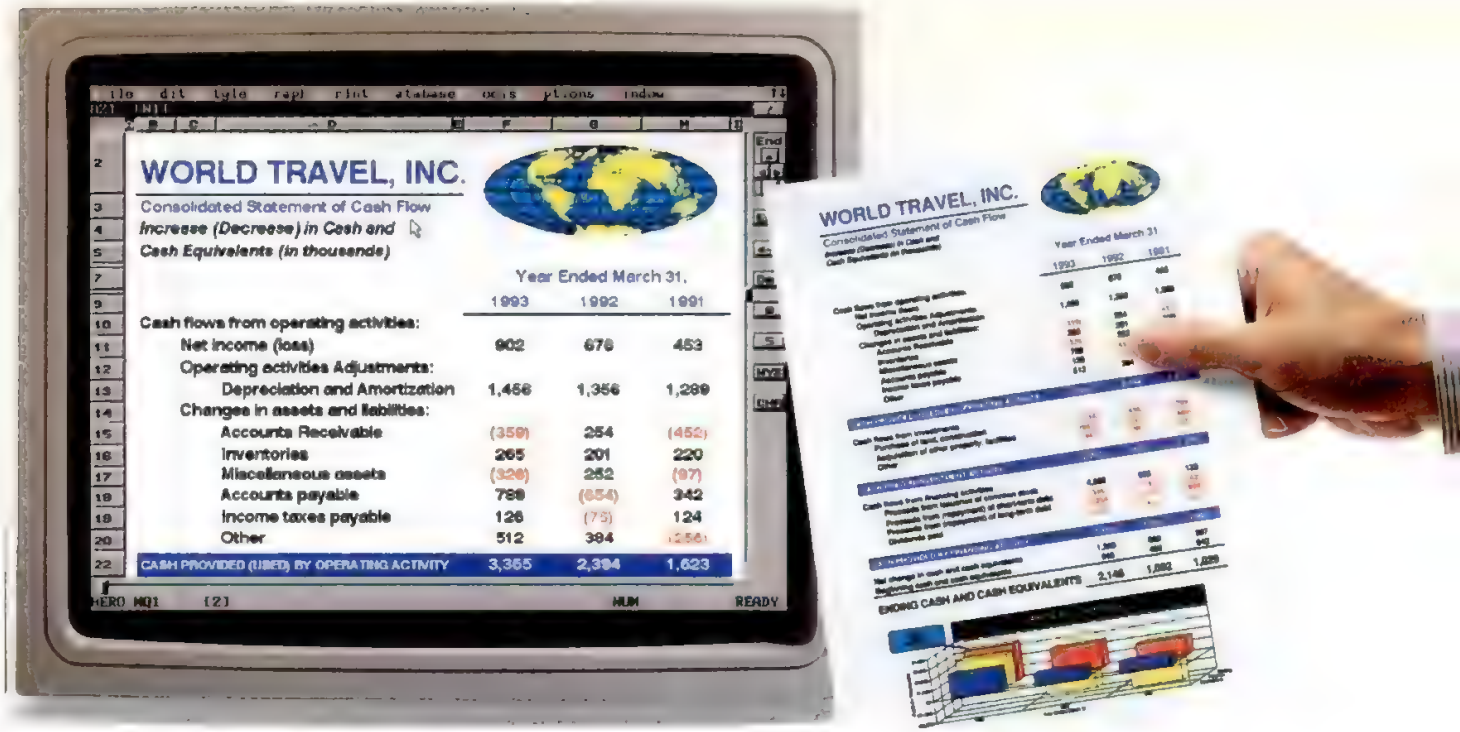
CIRCLE 439 ON READER SERVICE CARD

Color Hand Scanner Writes Directly to Hard Disk for Speed

NEW Designed especially for use in the *Windows* environment, **Mouse Systems Corp.**'s new hand-held color scanner, the PageBrush/Color, combines three-in-one black-and-white, gray-scale, and color functionality with its $795 *Image Prep* and *Image Quest* software bundle. The single-pass scanner offers 400-dpi resolution at 12 bits per color, and recognizes 4,096 distinct colors. A built-in 32K buffer on the 16-bit interface card lets you scan directly to your hard disk, avoiding any system RAM limitations.

Computer Presentations' image processing package, *Image Prep*, provides gamma correction, palette modifications, and global brightness and contrast controls along with 20

CONTINUES ON PAGE 60



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Borland's New Quattro Pro 3.0 WYSIWYG and WYSIWow!

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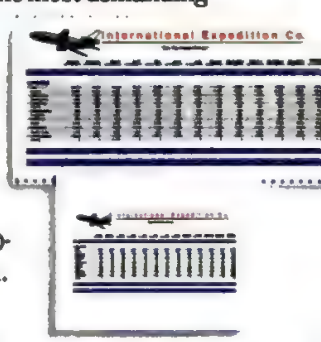
Choose from a spectacular library of fonts, colors, graphics and clip art to create winning presentations. There's even slide-show sound and transition effects!



New Banner and Print-To-Fit printing options let you print reports your way.

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Feature	Quattro Pro	1-2-3 r3.1	1-2-3 r2.2
"Live" editable WYSIWYG spreadsheet	Yes	Yes	No
WYSIWYG page preview	Yes	No	No
Banner (sideways-oriented) printing	Yes	No	No
Print-To-Fit™ automatically on a page	Yes	Yes	No
Backsolver technology built in	Yes	No	No
3-D graphs (ribbon, step, bar, area, pie)	Yes	No	No
Worksheet zoom	Yes	Yes	No
Draw package built in	Yes	Yes	No
Clip art library	Yes	No	No

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CIRCLE 287 ON READER SERVICE CARD

BRIEFS

Advanced Matrix Technology is shipping a 16-page-per-minute continuous-form laser printer to compete with line printers. According to AMT, the $4,995 TracJet prints 1,000 lines per minute at 300-dpi resolution. It comes standard with 2MB of RAM, and both a serial and a parallel interface. 805-494-4221.

GRAPHICS BOARDS

Everex Systems has announced the Viewpoint NI, a high-performance VGA card with 1,024-by-768 by 16-color noninterlaced resolution. The card is available in either a 256K ($199) or 512K ($219) version. 415-498-1111.

Visionetics International's VGALink is a single-slot, single-board, VGA-to-video overlay board with built-in genlocking. Working in conjunction with a VGA card and VGA software, the $695 board accepts both NTSC and S-VHS video signals, mixes this with the VGA display, and outputs the result in both NTSC and S-VHS. 213-316-7940.

Matrox has announced a new series of ultra-high graphics adapters. The MG-3D ($3,495) and MG-3D Ultra ($5,995) perform real-time rendering with a 32-bit digital signal processor, graphics ASICs, and a 16-bit buffer. The boards provide 1,280-by-1,024 resolution with 24-bit true color and are capable of surface removal and Gouraud shading with an independent light source. 514-685-2853.

LAPTOP PRODUCTS

MegaHertz Corp. has designed a 10MB-per-second Ethernet ($599) and a 4MB-per-second Token Ring ($999) LAN adapter for notebook PCs. Both external units provide a direct connection to the bus by utilizing the 100-pin bus expansion connector found on most Toshiba notebooks. 801-272-6000.

Moniterm Corp.'s Viking 3/91M is a high-resolution display system that features laptop compatibility. The $1,490 system combines a specially designed short-slot video board (the PC1280M) with Moniterm's most recent 20-inch monochrome monitor (1,024-by-1,024 noninterlaced resolution). 612-935-4151.

CONTINUED FROM PAGE 58

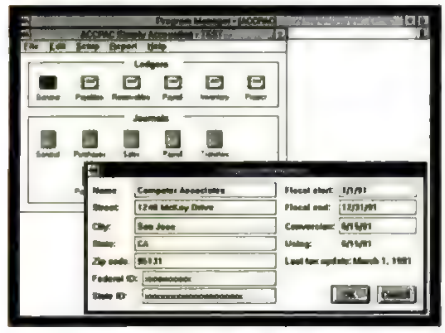
levels of image compression. For image comparisons, Mouse Systems' *Image Quest* displays up to six separate scans on the screen simultaneously.

List Price: PageBrush/Color, $795. **Requires:** 640K RAM, DOS 3.1 or later, *Windows* 3.0. Mouse Systems Corp., 47505 Seabridge Dr., Fremont, CA 94538; 415-656-1117.

CIRCLE 440 ON READER SERVICE CARD

Entry-Level Accounting: Computer Associates, Progressive Solutions

NEW *ACCPAC Simply Accounting* is a $199 entry-level, graphical accounting program from **Computer Associates** that runs under *Windows* 3.0. It has general ledger, accounts payable, accounts receivable, inventory control, payroll, and job costing modules. It allows you to import data from other programs into the general journal or export data to word processing and spreadsheet programs for further analysis. A network protection feature automatically locks data files so that only one workstation at a time can access them. Computer Associates International has also included a conversion utility that converts *ACCPAC Bedford* files to *Windows*-based *ACCPAC Simply Accounting* files.



For quick references, *Simply Accounting* provides pop-up lists of vendors, customers, accounts, and inventory.

Progressive Solutions has also introduced a *Windows* 3.0 accounting program, *Progressive Accounting*. The $129 program includes general ledger, accounts payable, accounts receivable, and reporting modules for double-entry accounting under *Windows*. It also produces mail-merge overdue notices and mailing labels. Progressive Software is packaging the program with fill-in-the-blank journal entries and detailed documentation covering basic accounting principles. Additionally, the program's collection screen includes a "Dial-it" function that automatically dials a customer's phone number from a selected invoice.

List Price: *ACCPAC Simply Accounting*, $199. **Requires:** 1MB RAM, DOS 3.0 or later, *Windows* 3.0. Computer Associates International Inc., 711 Stewart Ave., Garden City, NY 11530-4787; 800-531-5236, 516-227-3300.

CIRCLE 441 ON READER SERVICE CARD

List Price: *Progressive Accounting*, $129. **Requires:** DOS 3.0 or later, *Windows* 3.0. Progressive Solutions, 8640 N. Builford Rd., #228, Columbia, MD 21046; 301-865-3201.

CIRCLE 442 ON READER SERVICE CARD

Northgate Server Offers Several Intelligent Disk Subsystem Options

NEW **Northgate Computer Systems** has developed the OmniSystem network server along with an Intelligent Disk Subsystem (IDS) for the high-throughput requirements of today's local area networks.

The $13,995 OmniSystem comes with a 25-MHz 80486 microprocessor, 8MB of system memory, a monochrome VGA monitor and adapter, and seven EISA slots in its tower configuration. A 100MB-per-second proprietary memory bus provides the necessary bandwidth for dual processors and IDS. You can have the OmniSystem preconfigured with Novell *NetWare* and 32-bit Ethernet, Token-Ring, and ARCnet network interface cards.

The IDS comes in 800MB ($7,600), 1,200MB ($11,300), 2,400MB ($14,300), and 4,800MB ($22,000) versions. It achieves high-throughput rates by using dual SCSI channels and an on-board 386-based processor to arbitrate all input and output requests. Reading and writing directly to the system's main memory via bus mastering, the IDS leaves the main processor free to control other activities. It supports mirroring, duplexing, and data stripping.

List Price: OmniSystem, $13,995. Northgate Computer Systems, P.O. Box 59080, Minneapolis, MN 55459-0080; 612-943-8181.

CIRCLE 443 ON READER SERVICE CARD

$350 Asynchronous OS/2 Communications

NEW **Software Corp. of America** has released *TalkThru for OS/2*, a $350 Presentation Manager-based communications package. It supports asynchronous communications and IBM's Extended High Level Language Application Program Interface (EHLLAPI) under OS/2 Standard and Extended editions.

TalkThru provides terminal emulation for asynchronous protocols, file transfer, and SCA's own scripting language, AutoPilot, for building communications-based applications. It supports coaxial, asynchronous, and network EHLLAPI in environments. ■

List Price: *TalkThru for OS/2*, $350. **Requires:** 250K RAM, 2MB hard disk space, and OS/2 1.2 or later. Software Corp. of America, 100 Prospect St., Stamford, CT 06901; 203-359-2773.

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CODE: MV31

CIRCLE 295 ON READER SERVICE CARD

Improved

BRIEFS

WINDOWS DEVELOPMENT

The Whitewater Group has reduced prices, upgraded features, and added Borland's *ObjectWindows* graphics class library for its *Actor* line of *Windows*' application development software. Both *Actor* 3.1 ($249) and *Actor Professional* ($495) now offer support for DLLs for *Microsoft SQL Server* and improved filters for *dbVista* and *Btrieve*. *Actor Pro* creates standalone applications. 708-328-3800.

Knowledge Garden has added a math toolkit, a programmable mouse cursor, and performance improvements to its *Windows* development tool, *KnowledgePro Windows* ($695). 518-766-3000.

ProtoView Development now offers Version 3.10 of the *ProtoView Screen Management Facility* ($695; with the *ProtoGen Application Generator*, $894). The development tool for *Windows* adds new screen painter object classes, field control macros, DDE (dynamic data exchange) support, support for the Multiple Document Interface (MDI), print spooling, animation functions, and C++ compatibility. 908-329-8588.

WinSoft has released *Instant Prototyper* 3.0 ($99)—originally a subset of *Instant Windows*—as an entry-level *Windows*' application design tool. The product helps designers create and interlink windows, menus, buttons; it also offers data-validation functions. 415-324-9552.

WORD PROCESSOR ADD-INS

Stairway Software is now offering ScreenExtender 2.0 ($99.95; upgrades $30 plus shipping), a *WordPerfect* 5.*x* screen-enhancing add-in. The product offers 25 different screen sizes, can display 128 chracters per line, character size control, 6 screen fonts, and screen coloring. 800-782-4792, 804-977-7770.

Wordstar International has released *Wordstar Laptop Edition* ($295). The smaller version *Wordstar* 6.0 is bundled with Traveling Software's *LapLink Special Edition*, Campbell's *On-Time*, as well as a number of communications and remote access programs. 800-227-5069, 415-382-0606.

Microsoft Mail Connects Windows Workstations

IMPROVED **Microsoft** has acquired *The Network Courier* PC LAN e-mail system and optimized it for *Windows* users. The company states that the new system, named *Microsoft Mail for PC Networks*, will allow users to integrate other *Windows* applications and their data files with e-mail.

A single-user license includes a post office, message-transfer software for server-to-server and remote-user access, and DOS and *Windows* workstation software. The package provides gateways to MCI Mail, fax, MHS, X.400, PROFS, and SMTP and supports *LAN Manager*, Novell *NetWare*, 3Com Corp.'s *3+Open LAN Manager*, Banyan's *VINES*, and IBM's *PC LAN*. Microsoft promises links to OS/2 and the Mac later this year.

List Price: *Microsoft Mail for PC Networks*, *Microsoft Mail* server, $695; workstation 5-pack ($395); 20-pack $1,349; 100-pack $5,500; 500-pack, $22,500. **Requires:** Microsoft *LAN Manager*, Novell *NetWare*, 3Com Corp.'s *3+Open LAN Manager*, Banyan's *VINES*, or IBM's *PC LAN* networking systems; *Microsoft Windows* 2.11 or later, DOS 3.1 or later on workstation. Microsoft Corp., One Microsoft Way, Redmond, WA 98052-6399; 800-227-4679, 206-936-8661.

CIRCLE 446 ON READER SERVICE CARD

25K TFT Color Panel Added as Option for Dolch Luggables

IMPROVED **Dolch Computer Systems** is now offering Sharp Electronics' second-generation color TFT (thin-film transfer) LCDs as display options for their line of high-performance portable workstations. The 640-by-480 resolution screens are capable of greater color generation due to a collaborative effort by several companies. The screens are driven by a new video chip set from Chips and Technologies, the 82C457 flat-panel controller, in conjunction with Dolch's own color-generation pulse-width modulation and dithering algorithm, which allows simultaneous display of 256-color images from a palette of 24,389 available hues. Previous generation screens were limited to 8 simultaneous colors from a palette of 512.

Dolch's 680-by-480 LCD shows 256 simultaneous colors from a palette of 24,389.

The 10-inch (diagonal) active-matrix panels are available from Dolch as options in its Portable Add-In Computer (P.A.C.) line which includes 486/33 (EISA), 486/25, 386/33, and 20-MHz 386SX luggables.

List Price: Dolch 24,389-color active-matrix LCD, $3,995. Dolch Computer Systems, 372 Turquoise St., Milipitas, CA 95035; 408-957-6575.

CIRCLE 447 ON READER SERVICE CARD

PC-Kwik Adds Directory Sort

IMPROVED **Multisoft Corp.** has added both cosmetic feaures and an improved interface to its disk optimization package, *PC-Kwik Power Disk*. Version 1.1 sports mouse support for interactive mode; a directory sorter that allows organization by extension, name, date, time, and file size of the active directory and all subdirectories; disk mapping and individual cluster viewing in ASCII and hexadecimal notation. Users are now able to view individual file locations and fragmented files, too.

List Price: *PC-Kwik Power Disk*, $79.95; upgrades, $49.95. **Requires:** 256K RAM (384K for disks over 32MB), hard disk, DOS 2.0 or later. Multisoft Corp., 15100 SW Koll Pkwy., #L, Beaverton, OR 97006; 800-759-5945, 503-644-5644.

CIRCLE 448 ON READER SERVICE CARD

Info Select Adds Fuzzy Searches

IMPROVED **Micro Logic** has added fuzzy searching, LAN support, and infobase sorting to its personal information manager, *Info Select*. Version 2.0 of the product, which is the second generation of *Tornado*, now allows you to match the target word in a search with a set of closest approximations. In addition, Version 2.0 lets you eliminate duplicate entries when combining several infobases.

Also new is automatic address recognition for easier label and envelope printing, autodialing, and network file locking. The interface now offers drop-shadow style windows, up/down cursoring, and enhanced selection of large notes. *Info Select* will run on any network that offers file sharing. ■

List Price: *Info Select*, Version 2.0, $149. **Requires:** 256K RAM, DOS 2.0 or later. Micro Logic Corp., P.O. Box 70, Dept. P, Hackensack, NJ 07602; 800-342-5930, 201-342-6518.

CIRCLE 449 ON READER SERVICE CARD

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PC MAGAZINE *Service and Reliability Survey 9/25/90*

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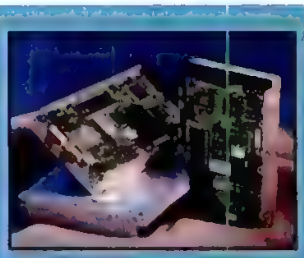
w/100MB (17ms)IDE	$1945	$1995	$2145	$2345
w/200MB (16ms)IDE	$2445	$2495	$2645	$2845



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CIRCLE 268 ON READER SERVICE CARD

edited by
Matthew J. Ross

Read Only

Reviews of the Latest Books for the PC User

Fully Powered Windows: An Underpowered Look at Windows 3.0

Windows 3.0's spectacular success has produced a feeding frenzy among computer book publishers. The first round of books tended to be user-friendly renditions of the *Windows* manual. Now, the second wave addresses more-sophisticated users. Burton Alperson's *Fully Powered Windows* (subtitled "Getting the Most Out of Your 386 Computer") is an eclectic set of tips that deal as much with a power setup on your 386 computer as with *Windows*.

Alperson misses the mark through much of the book. Over one quarter of it is documentation for *PKZIP*, a shareware file-compression utility that is not even *Windows*-specific. Another quarter is documentation for 11 other shareware utilities including a screen blanker *(Magic)*, disk cache *(Hyperdisk)*, wallpaper organizer *(ZiPaper)* and icon editors *(Icondraw* and *PTBicon)*.

Most of the programs on the disk are evaluation copies of programs that require a fee if you decide to use them. Of special interest is a free library of over 500 color icons and a set of programs by the author that juggle multiple CONFIG.SYS/AUTOEXEC.BAT pairs.

In the final analysis, only about one third of the 450-page book deals with tips and background material. Plus, the textual material is uneven. I was particularly disappointed in the discussion of memory issues. The presentation of EMS memory is little more than jargon; it will not enlighten those puzzled by the term. Particularly puzzling in a book on optimizing a 386 is a total lack of any discussion of *QEMM* or *386MAX*.

The discussion of timeslices and differences between multitasking DOS and *Windows* applications is excellent, as is the discussion of PIFs. But too many topics are left out that one would expect to see in a book on *Windows*. The most serious omission is DDE, which gets only a few sentences. There is also almost no discussion of ports or fonts. Also missing are discussions of the advanced options in the WIN.INI and SYSTEM.INI files, or any discussion of the Macro Recorder. The writing style is conversational and approachable and some topics like the coverage of PIFs have some insights, but other books do it better.
—*Barry Simon*

Fully Powered Windows
by Burton Alperson, $39.95 (includes two disks), A Brady Book, Simon & Schuster, New York, NY 10023; 800-624-0023, 212-373-8093.
ISBN 0-13-332859-7
CIRCLE 397 ON READER SERVICE CARD

Maximizing Windows: The Power User's Reference to Windows 3.0

Jim Boyce's *Maximizing Windows 3* is clearly the pick of the crop here. It has a thoroughness and clarity that is admirable. For example, consider his discussion of DDE. Too many DDE discussions describe only paste link, and give a cookbook description of how to paste in from *Excel* by creating a DDE hotlink. Such a mechanical absolute row/column range link in *Excel* will be corrupted if cells are moved in the worksheet. The solution is to use a named range but this problem and solution are too often ignored. Boyce explains the issue clearly.

Boyce goes on to describe in detail other aspects of DDE commands, both server and client commands, something of great value to the writers of *Crosstalk for Windows* scripts or *Excel* and *Word for Windows* macros. However, while the descriptions are excellent, additional examples would have been useful.

DDE is discussed as part of a series of chapters on connectivity that includes a presentation of network issues such as using a network printer. Two software products—*Windows Workstation* and *XVison*, a link to X Windows—are described with considerable attention paid to specific clipboard formats.

Maximizing Windows 3 includes a cornucopia of other topics beyond the typical PIFs and fonts discussions you find in the other books. There are interesting discussions of color schemes, icon usage, and tips for using the *Windows* Recorder. In addition, minireviews of third-party programs like hDC's *First Apps* and *Express* are sprinkled throughout the discussions.

The final chapter discusses *Windows* programming, including *ToolBook*, *The Whitewater Resource Kit*, and even the *Windows SDK*. The discussion of memory issues is complete and very clear, and the segment on *ToolBook* goes so far as to include some programming hints.

Even with this great wealth of information, Boyce's style is so unintimidating that the book is suitable for intermediate users as well.

Like the competing books, there is a disk of shareware and programs by the author, but here the documentation is almost entirely on disk with the exception of an overview in an appendix. Included on the disk is a disk cache *(Hyperdisk)*, *PKZIP*, and a variety of shareware programs. Boyce also includes the same free collection of icons found in Alperson's book, as well as *Command Post*, *Icondraw*, two toolbooks, a screen saver, and a program to read GIF graphics files in *Windows*.

This is a reference that every serious user interested in a deeper understanding of *Windows* will want on their bookshelf.—*BS*

Maximizing Windows 3
by Jim Boyce, $39.95 (includes one 1.2MB floppy disk), New Riders Publishing, Carmel, IN 46032; 800-428-5331.
ISBN 1-56205-002-8
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Maximizing Your Understanding of DDE

DDE gives you a way to share data between *Windows* applications while remaining confident that if you change the source data, the copies of it in your other documents will also change. When information is linked via DDE, the dependent applications are notified that a change has occurred to the data and can update their copy of it accordingly. Instead of manually changing a whole group of documents, and very possibly missing one, DDE automates those changes.—Jim Boyce's *Maximizing Windows 3*

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Oriel Batch Language is the Tool to Help Power Users Customize Windows

Windows 3 Power Tools by Geoffrey LeBlond, William LeBlond, and Jennifer Palonus includes software documentation, but unlike Alperson's book, the LeBlond group confines the documentation to the last quarter of the book, where they discuss three shareware treasures: *Command Post*, a *Windows* shell for those who don't like icons, *Aporia*, an object-oriented shell which is more iconic than Program Manager, and *Icondraw*, a utility to create and edit icons. The disk included with the book also includes a shareware editor called *Winedit*, which, like the other shareware products, needs to be registered if you continue to use it.

The LeBlond group also includes a substantial utility of their own called Oriel, so this book review is partially a software evaluation. Oriel is a batch language for *Windows*—a powerful language that has been impressively squeezed into only 18K of code. Oriel's graphical abilities go way beyond other batch languages such as Bridge Batch and BatchWorks, but unfortunately, it is lacking in user I/O, flow control, and string manipulation capabilities.

Oriel has menus and message boxes, but no dialog boxes. It has "if" and "goto" but no "else" or explicit loops. It doesn't have string variables or comparisons. On the other hand, its primitive drawing capabilities include 13 drawing commands and other tools to let you fashion impressive graphical front ends and menus.

I can't help feeling that the typical end user would want strings and dialog boxes; there are enough ways of wasting time with *Windows* without creating fancier front ends. In this light, Oriel may be of more interest to developers than to typical *Windows* power users.

The book itself contains an adequate but not outstanding discussion of basic and advanced topics such as DDE, fonts, and memory management. For example, the discussion of DDE is limited to paste link only and there is no discussion of the ranges issue discussed in Boyce's *Maximizing Windows 3*. The chapters on Program Manager and File Manager are rather pedestrian, although a much more interesting one follows on the use of the Macro Recorder. The chapters on memory and disk use are thorough and excellent. So is the coverage on options within WIN.INI and SYSTEM .INI files.

The writing is clear, but the density of presentation is often overwhelming. The book would benefit from a bit of consolidation and clarification, overall. Nevertheless, the Oriel batch language and the shareware offerings make this an interesting option for the *Windows* power user to consider.—*BS* ■

Windows 3 Power Tools
by Geoffrey LeBlond, William LeBlond, and Jennifer Palonus, $49.95 (includes 1.44MB disk), Bantam Books, 666 Fifth Ave., New York, NY 10103; 800-223-5780, 212-765-6500
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edited by
Trudy Neuhaus

Toolkits

Reviews of the Latest Tools for the PC Programmer

Object Toolkit Lets You Ease Into Object-Oriented Programming

You would have to have been in hibernation for the last few years not to know that the PC world has fallen in love with object-oriented programming (OOP). Well, at least the *idea* of OOP. Inheritance, encapsulation, and polymorphism—the cornerstones of OOP—offer programmers a way to impose order without setting limits.

Following on the heels of this new order come new libraries. Third-party class libraries will take the place of more-traditional function libraries. Object Toolkit from TechnoJock Software is a good example.

Object Toolkit is designed to work with Borland International's Turbo Pascal, Version 5.5 or later, and requires an IBM PC or compatible with DOS 3.0 or later and 640K of memory.

Object Toolkit places its focus squarely on OOP and the user interface. It is a collection of objects and methods, neatly organized into a hierarchy. You can use its tools to create moveable, scrollable windows, to control input fields, and to handle string, integer, floating-point, and date input so that forms are easy to create. It also supports linked lists, menus, and mouse and keyboard input.

It delivers its tools in Turbo Pascal Units; totLOOK, totSYS, totFAST, and totWIN are a few examples. These Units include a variety of Object Types, and the Object Types, in turn, provide a variety of methods. A few of these Units automatically initialize certain related instances of Object Types (that is, object variables). So, for example, to incorporate some basic interface management into your application, you would use the totFAST unit. Among other things, this will initialize SCREEN, an instance of the type ScreenOBJ, for writing to the screen.

The Object Toolkit is accessible as well as powerful. Its documentation is generally lucid and well organized. It includes a brief introduction to the concepts of objects and object-oriented programming. Unfortunately, it may be a bit too brief. Although the segue into a discussion of how to use this Toolkit is graceful, once you're there, you may stumble on a few nonstandard object-oriented terms. For example, Object Toolkit seems to use the terms *object instance*, *global instance*, and *global object* interchangeably. However, of the three, only *object instance* is a standard object-oriented term. TechnoJock Software said it will correct the inconsistency in the next printing.

But these anomalies don't impede your progress for too long; you'll be up and running rather quickly, whether you are an OOP expert or not. Of course, the better you understand OOP, the better you'll be able to exploit Object Toolkit.

The Object Toolkit includes one manual and two disks, which unpack into less than a megabyte of hard disk space. The Toolkit also includes, of all the quaint things, Flash Cards. These handy reference cards cover everything from the object hierarchy to ASCII codes to composite display attributes. It's refreshing to see that something doesn't have to be overly complicated to be highly technical.

Are you wondering why you need Object Toolkit when you already have Turbo Vision? After all, isn't that the purpose of Turbo Vision—to design user interfaces?

Besides addressing more-advanced data input and validation issues than Turbo Vision, Object Toolkit also offers a more modular approach to programming. You can pick and choose the tools you want to use. All the objects in Turbo Vision, on the other hand, are related; it's a one-size-fits-all environment.

Turbo Vision also adheres strictly to one set of development rules—rules that extend beyond object orientation to event-driven programming. Based on a model that closely resembles *Microsoft Windows* programming, Turbo Vision requires that you use the event-driven model to create text-mode *Windows* interfaces.

Object Toolkit doesn't use the event-driven paradigm; indeed it doesn't even insist that you use a windowed interface. This gives you more design freedom. And for all of you who still value speed above all else, Object Toolkit includes objects written in assembly that write directly to the screen. It is the only part of the Toolkit programmed in assembly.

There are a great number of tasks suitable for Turbo Vision's application framework, event-driven approach—prototyping is one example. However, if you're looking for an introduction to OOP that will not overwhelm you, and you're already familiar with Turbo Pascal, this is the toolkit for you. In just a few minutes and only 26 lines of code, I created a dialog box in a shadowed, moveable window. TechnoJock is no stranger to Pascal, having provided libraries for that language since 1986. And since Object Toolkit is available as try-before-you-buy shareware with complete source code, how can you resist?—*Rick Ayre* ■

Figure 1: A few lines of code is all it took to create a dialog box in a shadowed, moveable window.

Object Toolkit

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Bill Machrone

Future Perfect

Some of today's hottest developers are talking about *Windows* in the past tense. What do they know that you don't?

That vague feeling you have of being a little behind the power curve these days isn't just a suspicion. You really *are* out of sync with the captains of industry. This idea first occurred to me at PC Forum, the annual symposium run by industry commentator Esther Dyson. Each year leaders in the hardware and software community gather to consider the state of the art, take stock of where we are, and to debate the future. Coming from the workday world of product reviews and deadlines, it can be heady stuff.

This crowd isn't thinking about character mode versus graphical user interface. GUIs are old hat, taken for granted. To this crowd, today's graphical interfaces are little more than a pretty face, lacking the underlying object orientation and development tools to answer tomorrow's computing needs. Pen-based interfaces are a given, even though not one of the new-generation pen-based computers has shipped yet. (I'm not ignoring GRiDPad; it runs DOS, not an object-oriented environment.) These industry leaders are arguing the merits of Microsoft's *Pen Windows* versus Go Corp.'s *PenPoint*.

They're looking for ways to sell new computers to new customers. More than one speaker made the point that the average user is on his second or third computer, meaning that we're reselling machines to the same customer, not expanding the market.

New technology won't automatically expand the market, but it can set the stage for reaching new users. Some of the hottest targets are noncomputing executives, mobile white-collar workers, and even blue-collar workers. Pen-based interfaces are logical platforms from which to build this push. My sense is that the products under development will have relatively little effect on our day-to-day personal computing lives, at least at first. It'll take some time for the new technologies to backfill into desktop platforms and applications.

ILLOGICAL EXTREMES?

Likewise, multimedia computing is not going to be a runaway hit on the average user's desktop. It'll revolutionize entertainment and educational computing first. We'll extend the educational aspect into business training, too. Next it'll find its way into a desktop presentation or two. Then multimedia-capable e-mail will allow you to say the things that you could never write properly, and send them over your network as voice objects.

Hewlett-Packard's *NewWave* architect, Bill Crow, showed me an example of the extreme to which multimedia computing can be taken. His experimental, personal version of *NewWave* gives you audible confirmation of most operations. When you open a file, you hear the classic door-opening sound effect: cli-click... creaaak. When you close a file, you hear a decisive slam. Windows make zooming noises when you zoom them. An office full of machines so equipped would be bedlam. But I can think of numerous instances where you want an audible confirmation that your computer did something, and there's a limit to how many different variations of the old-fashioned speaker beep you can tolerate.

All these added capabilities are making the software development environment more and more complex. And if there's anything we don't need right now, it's longer development times. Consequently, everyone's talking about development environments and languages. Turbo Pascal for *Windows* is a reality. C++ is

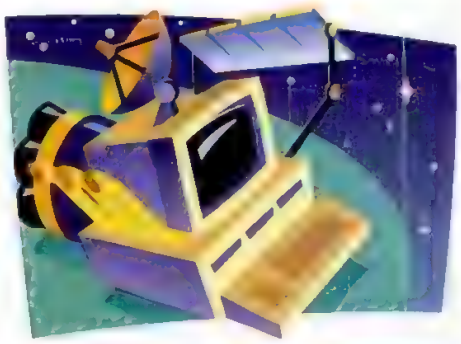

ILLUSTRATION: DON BAKER

a standard. But I'm amazed at the amount of energy and attention directed to a language that I thought was dead: Smalltalk. It's back, and it's better than ever. It's ideally suited to today's graphical user interfaces because it's inherently object-oriented. It's economical, robust, and performs well. I find it more comprehensible than C, but it's not as wordy as Pascal. It's not as user-friendly as Microsoft's forthcoming WinBASIC, but it offers significant advantages to the developer.

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Bill Machrone

MEANWHILE, BACK AT THE OFFICE

You're still trying to get everyone to use the same word processor and spreadsheet. Your users are still bringing new software in via the back door. Your training and support costs are going through the roof. Not only are your efforts futile, they're also wrongheaded. The goal of the future-thinkers is to let everyone use whatever software they're most comfortable with to get the job done. The future is in snap-together software. Right now, you can use *Windows*' DDE capabilities to bring an address from a PackRat card directly into a *Word for Windows* document, without all the hassle of cutting and pasting.

Object linking and embedding (OLE, pronounced the Spanish way) goes even further. In the future, thanks to OLE, you'll be able to use *WordPerfect for Windows*' spell-checker and thesaurus from inside your *Microsoft Excel* spreadsheet or from any other OLE-aware application.

The movers and shakers, however, want to do more. They want to confer the Unix-like capability to use whatever pieces of whatever applications do the job best for you, without the Unix-like pain of shell programming or intimate knowledge of each application. You'll be able to assemble the bits and pieces of software and data that do the job best for you and give them a name, so that others will be able to use them, too, as though they were a custom application.

Patriot Partners, the IBM-Metaphor collaboration, is working on the snap-together aspect, while Adobe founder and CEO John Warnock is fighting what he calls "ASCII Jail." Warnock says it's absurd to exchange documents at the ASCII level or to go through convoluted format conversions, when a rich page description language such as PostScript can be extended to become a document interchange layer that works on IBM-compatible, Macintosh, or Unix platforms. Adobe has already demonstrated the basic document exchange capability; now it remains to make it into a product and a standard.

Let's turn around Satchell Paige's immortal advice, "Don't look back; something might be gaining on you." Look forward instead; the future is gaining on you. ■

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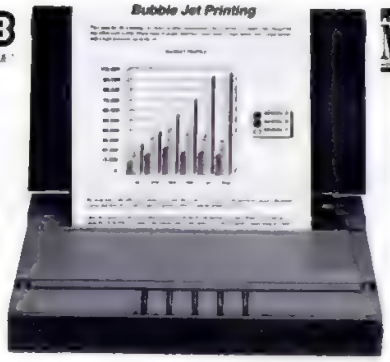

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John C. Dvorak

It's a Sucker's Game

If the PC industry is as confused and split over conflicting strategies as people think, how come so much money is being made?

This industry always looks confused. Currently, it appears that baffling dichotomies abound. Just don't believe it. The topsy-turvy scene is part of a complex blueprint designed to keep the public interest in computers high.

I first noticed the situation at a recent *PC Magazine* Editors' Day when a disk drive add-on vendor was showing off a 300MB hard disk that cost far less than the IBM equivalent. The machine he had was an RS6000 RISC machine running modified Unix.

If you haven't seen the RS6000, it doesn't look much different from a large 386 box except that it's as alien to a PC as a mainframe, even though it looks cuddly.

While I was looking at this RISC machine and hearing about a slew of new screamer workstations, I walked over to talk to another fellow. From his perspective the hot item in the computer business was a cheap sub-$500 8088 box. Asking around I found a boatload of people still selling 8088 boxes.

Does this sound like a market split to you? Or is it just the same split that's always existed between microcomputers and minicomputers, and now the boxes just look more alike?

I opt for the latter answer. In fact, there are no splits. No dichotomies. Everything that looks like a split is a mirage. There's downsizing and upsizing. It sounds like a dichotomy, but it's two words for the same thing. There's networks versus multiuser. If you look closely at the most popular network, *NetWare*, and see how it's being used, you see that it's just a new and cheaper way of doing multiuser.

Meanwhile, we have the biggest fake dichotomy there is: the easy-to-use GUI versus the hard-to-use command line interface. The proof that something is amiss with this one comes straight from Microsoft. At its recent strategy session, Microsoft positioned MS-DOS as an entry-level product and *Windows* as an intermediate product.

This flies right in the face of the overpromoted notion that the GUI is for beginners and the command line is for more-advanced users (because, presumably, it's so darn hard to use—hah!).

This contradiction matches the theme of the 1990s as expressed by Bill Gates at the Fall Comdex keynote: The machines of the next decade must be more powerful *and* easier to use. I assume that Gates wants more power to run a complex operating system whose overhead munches CPU cycles to accommodate idiot users. So you have more power, but it's chewed up by being easy to use. It will never be easy to use. Dvorak's Dictum: *For a computer to be efficient and powerful the user interface must have some complexity.*

So the notion of easier-to-use computers is hot air. The user interface, whether DOS, *Windows*, or the Mac OS, is as easy as it gets. So what's the point of creating this atmosphere? What's the point of promoting the concept that easy to use is just around the corner?

Sometimes you wonder whether the Microsofties actually believe this stuff. Waiting for the easy-to-use computer is like waiting for Godot. How easy do these things have to be? Let's face it: The machines of today are not difficult to use. Kids use them. Few of these kids are geniuses.

The easy-to-use/hard-to-use dichotomy all seems to be a function of churning. Microsoft

ILLUSTRATION: DON BAKER

is doing itself a favor by churning the market with promises of this new-and-easy-to-use nonsense. It keep interest high. Machines sell. People are stuck with DOS or *Windows* and are forced to spend a day to learn a few commands or learn how to click a mouse. Once they buy the machine, they're hooked. *That's* the real theme of what's going on around us—tricking the reluctant holdouts into buying computers. Hey, whatever works!

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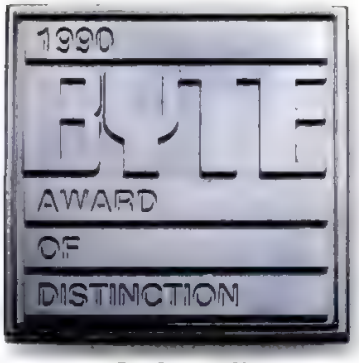
PC Magazine, December 11, 1990

PC World, May 1990

InfoWorld: Product of the Year, February 4, 1991



Byte, January 1991

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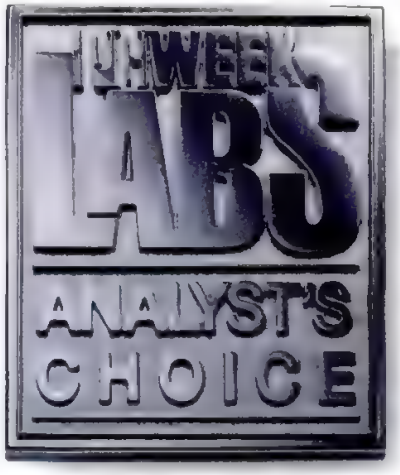

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John C.
Dvorak

Inside Track

There's an **old saying** in the world of computers: There are three kinds of liars: 1) plain liars, 2) damned liars, and 3) **benchmark tests.** But it seems we never take this axiom to heart. The public is still inundated by benchmark tests. The tests are used to prove that this machine or that machine is faster than brand X. The most **ludicrous** example of this happened when Hewlett-Packard released its newest line of workstations, the HP9000/700 series, showing benchmark test results that were **stunning,** to say the least. When one HP employee passed around a set of these I had to call a few people to ask him what gives. These machines can't be *this* fast.

Compare some of these numbers: ANSYS SP-3 results (smaller = better):

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HP9000/730,750 G/CRX	49
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HP9000/720 G/CRX	66
IBM 6000/540	68
DECstation 5000	145
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Sun SPARCstation 2	225

> There's no way the HP9000/700 workstation is half the speed of a Cray, unless they mean Robert Cray—the guitarist.

The first thing I was told is that the most **misleading** aspect of the above box of numbers is that the Cray is so fast that all that the 27 represents is **nothing but system overhead.** If the ANSYS SP-3 test was 100 times more complex it's quite possible that while the HP9000 clocking in at 49 would have jumped to 4,900, the Cray might still be 27. Fact is that in no way whatsoever is this machine **half the speed of a Cray 2,** unless we're talking about Robert Cray—the guitarist. **I'll challenge anyone** in the computing world to tell me these numbers reflect reality.

While the new HP workstations are a nice use of RISC, they may **not be as fast** as everyone would like to believe. One CISC advocate familiar with the machines told me not to be surprised to find these machines are about 25 percent faster than a 486 machine running at the same clock speed. In other words, keep your PCs, folks.

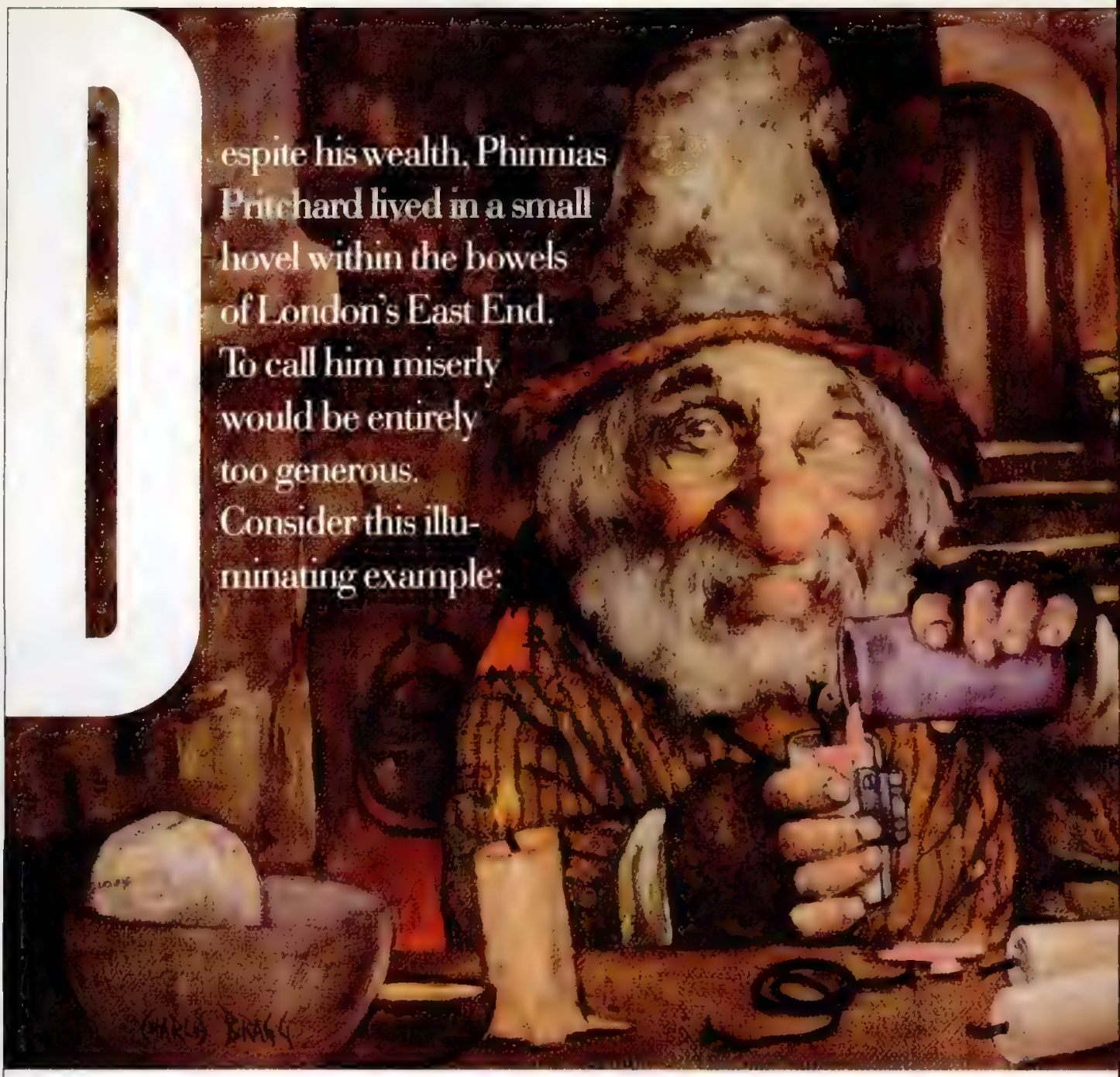
Piracy Lurks Dept.: I got a Sony DAT player for my birthday and discovered that it comes with a nice fiber-optic digital connection allowing the user to hook it directly to a CD player and simply **download the CD digital code.** How nice. Accordingly, a DAT cassette could easily hold two or three copies of any CD-ROM on the market today. I can see a market for DAT backup just so users can **copy all the CD-ROM disks** they can get their hands on. Yes, more bootlegging. This, in the minds of the **larcenous,** pays for the DAT machine with the one-time copy of a $900 database. While the DAT audio recorders have employed some sort of encoding to prevent multigenerational copies of CD disks, this isn't the case with data DAT.

It won't matter because the future CD-ROMs **won't be copyable.** What this means to the rest of us is that CD-ROM will be **further impeded** by the **gougers** who overprice CD-ROM databases. A slew of proprietary file conventions must be employed to ensure that the database is being used only from a CD-ROM and not from a copy loaded onto a large hard disk. Since nobody will agree on just how to do this, there will be a bunch of **incompatible interfaces** and confusing installation methodologies. Will this mess ever end? How about making the prices of CD-ROMs reflect the cost of manufacture? End of Diatribe 693.

Genuinely Interesting Hardware Dept.: At a recent *PC Magazine* Editors' Day I ran into a company called **Ergo Tech.** The Corona, California based company (714-279-1345) makes a unique $29.95 PC Soft lens that does wonders for a display. It's a piece of **specially designed** plastic that fits onto a monitor screen, not unlike a soft contact lens. The image is noticeably **crisper.**

Also from Ergo Tech is an amusing thing called a "Laptop Visor." The $20 Laptop Visor is like **a giant lens hood** that goes around the outside of a laptop screen. It looks perfect for using a backlit screen laptop in the bright sun of **Waikiki beach.** I'm told it similarly functions as a security device to keep **prying eyes** off those **confidential memos** some of you carelessly write while flying in Business Class and while **surrounded** by the competition.

The Ergo Tech personnel also introduced me to a **fascinating device** called an ELF/VLF Meter from a company called Safe Technologies, 152 Milk St., Boston, MA 02109; 617-444-7778. This hand-held gizmo measures the **electromagnetic radiation** emanating from a VDT. It's pretty stupefying to see it pick up the magnetic field **3 feet away** from many monitors! NEC MultiSyncs really throw out a field, I can tell you. While I'm not one of the nervous nellies who have concluded that magnetic **radiation causes your brain to turn into mush,** I am impressed that the magnetism can be measured as far away as this device can detect it. One thing I observed is that the new lower-**radiation** monitors do indeed have much lower readings. If you're the **health and safety** type, or if you sell low-magnetic-field monitors, you want one of these gadgets today. They cost $250. ■



Rather than spend a half penny for new candles like everyone else, Phinnias would make the rounds of local establishments, scrape the tallow drippings from old candleholders into a sack, and later melt the contents to make new candles. On one particularly productive evening he collected six scrapings from a pub, four from a butcher's shop, twelve from a church abbey, eight from a neighborhood inn, ten from a local

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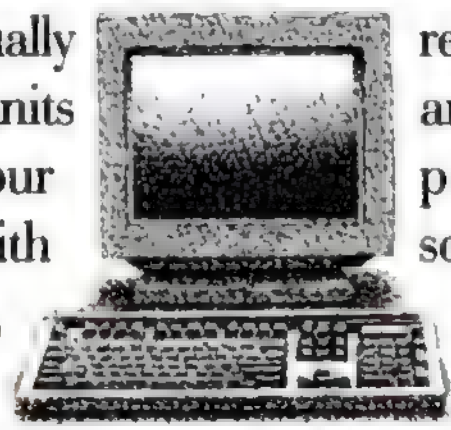
cockfighting hangar and nine from a cobbler's shop. Query: If it takes the remains of seven candles to make one new candle, and if one candle lasts an entire night, how many full nights of light was he able to create from this trip?

Certainly it's hard to quarrel with Mr. Pritchard's motives. Especially in this era of revered recycling. But, one could legitimately question whether he was receiving an adequate return for all the effort he expended. (Though it did yield in excess of seven candles.)

One could also question what all of this has to do with Wyse.

Believe it or not, quite a bit.

Because—in the interest of ergonomic reform—we are conducting a sort of recycling effort of our own. From May through August we are paying $50 for any antiquated terminal traded in on a new Wyse WY-150, WY-160, WY-185 or WY-370.



Obviously, we don't actually recycle the parts into our new terminals. But we will see that the old units are properly dismantled and disposed of, then recycle $50 into your pocket. A nice return for very little effort. So if you are still cursed with some ergonomically archaic terminals, here's your chance. After all, having shipped over three million terminals worldwide in the past decade, we know a little about how to build new ones. Which helps explain why we are able to offer such a broad line of industry-standard terminals with a combination of features and ergonomics unsurpassed by competitive terminals. User-comforting ideas like our unique detachable keyboards with light-touch keys and high tactile feedback. Tilt & swivel monitor bases and higher refresh rates plus overscan video for flicker-free images. All at price/performance ratios that are controller-comforting.

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By now the attentive reader has learned two things: Mr. Pritchard's recycling program netted him more than seven candles and Wyse's recycling program can net purchasers several hundred dollars towards the industry's finest terminals.

Don't stop now.

WYSE

The answer to terminal replacement problems can be found in our unique $50 trade-in offer.
The answer to Pritchard's problem can be found on page 459.

DOS

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Jim Seymour

Old Bottles... Old Wine

Innovative new software in the PC industry has been replaced by updates, incremental fixes, and the bloat of featuritis.

If you measure what's happening in the PC business by the securities analysts' views, this is a pretty sleepy year. Annual hyper-increases in hardware and software sales are over. Some vendors are having a flat year, while most others are seeing just small gains. Microsoft is getting bigger and richer, Bill Gates grows more and more powerful. Yawn.

Wall Street doesn't see many fundamental changes underway. Nothing, certainly, as interesting as they find this year's round of Bill bashing.

But beneath a placid surface, some real changes are moving through the PC business. I'll leave The Microsoft Threat, The Decline of Computer Retailing, and Oh, Woe, Where Did the Venture Capitalists Go? for another day.

What I find more interesting is the fundamental change going on in the nature of innovation in the PC software business.

Since the long-ago days when the Apple II was ascendant, and certainly since before the first IBM PC appeared ten years ago, innovation has been expressed in the software business by a steady stream of new programs. New programs let us bring new jobs to the PC, or at least tackle old jobs in fundamentally different and better ways. And these new programs came from a great variety of new companies.

Most of those companies and products, failed, of course. The first "integrated" PC program, *Context MBA*, got clobbered by *Lotus 1-2-3*, released at almost the same moment. It turned out that what people wanted was a great spreadsheet, and would put up with feeble and inconvenient graphics, and marginal database features, to get that great spreadsheet. *Context MBA* sank like a stone.

ONLY THE BEST SURVIVE

The PC software business has been, in the main, a kind of marketplace meritocracy, so that the good stuff usually won out. A few sad exceptions to the rule—the painful failure of *Javelin*, for one—tended to underscore the general principle. The imaginative, innovative stuff survived; the rest disappeared.

The market was a healthy one, with relatively easy entry, prospects for serious commercial success and commensurate financial rewards, and enough frenzy and turbulence to let the good stuff rise to the top.

But today, a fundamental change is underway. Today, we don't get many new entries of that sort—new programs, coming from new companies, to let us tackle new jobs at the PC or change our approach to old ones.

We now look for innovation in extensions of existing products. Rather than finding a dozen interesting new word processors every year, we look instead to the new upgrades from WordPerfect and Microsoft for innovation. What we get, of course, is incremental fixes, long-overdue features, and the bloat of featuritis, but not innovation. Innovation doesn't grow out of tweaking but from starting afresh.

Windows promised some relief. But despite such entries as *Ami* from Samna/Lotus and the new *Signature* word processing package from XyQuest/IBM, the real game remains Microsoft versus...you guessed it, WordPerfect.

Will *WinWord* be enough to knock *WordPerfect* out of the top slot? Will the new *Windows* version of *WordPerfect* keep Utah comfortably ahead of Washington? Will Sally marry Eddie? Will Luisa run away with....

ILLUSTRATION: DON BAKER

In fact, that's just the point: Rather than fostering real innovation, the software market today seems to be slipping into a drab soap opera.

Some say this lack of innovation is the inevitable outcome of a relatively mature market with the accompanying dominant players and high entry barriers.

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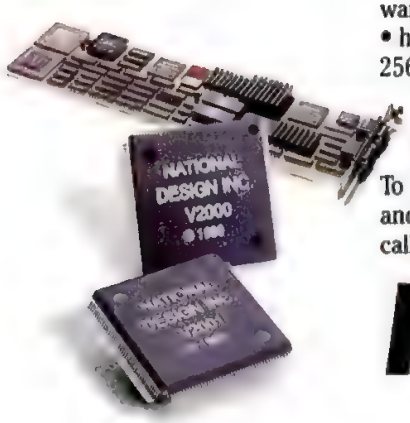

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Jim Seymour

Others say innovation is going by the boards because that's what big customers want. Major companies have so much invested in present software—not only the first cost of purchase price and installation, but also the huge software-infrastructure costs of training and support—that they don't *want* much innovation. Just let these customers doze quietly in the sun, cynics say, and they'll be happy.

There is some truth in the first, market-dynamics analysis, but only the appearance of truth in the latter. In fact, major customers are screaming for what we used to call innovation—new kinds of products to undertake new jobs.

They sense that current applications have in many cases become so feature-rich that little of importance remains to be added. Beyond the Holy Trinity of PC hardware and software demands—smaller, faster, cheaper—they're content.

But they're far from content overall. Anyone who doubts how willing American businesses are to buy PC software need only look at the last year's adoption rate for *Windows* 3.0. Tens of thousands of managers, in thousands of companies, gambled a piece of their credibility, and maybe their careers, on "the *Windows* decision." No company using *Windows* thinks there are enough *Windows* apps available yet to fully justify that enormously expensive change; yet they've gone ahead with it, as a bet on the future.

What they *don't* want now is a "more of the same, a little bit better, and a little bit faster" future. They tell me they made the shift to *Windows* because it seemed a hope for recovering the "innovation initiative" in this business.

A WARNING FOR TOMORROW

Maybe innovation isn't yet dead in PC software. Maybe we haven't succumbed to creeping incrementalism as a substitute for genuinely new ideas and new products. But it sometimes seems so.

Failing to arrest this painful change in the PC market—or acknowledging it, then nodding off again—could be deadly for even the largest and most successful companies. And devastating for their customers.

Next time, I'll tell you what I've learned in talks with others about what's happening in PC software. ■

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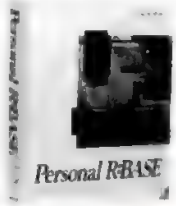

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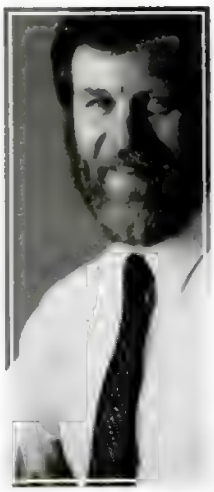

And the Winner Is...

In the wide world of personal computing, there is ample room for more than one operating system.

Which operating system will win in the 1990s? Posing that question seems as reasonable as asking which team will win the World Series in 1991. We may not yet know which ball club will prevail, but we do know that one team or another has to eventually win. Similarly, all the controversy over *Windows*, OS/2, Unix, and so forth makes it tempting to assume that one operating system will ultimately triumph. It seems natural that one of the competing operating systems will dominate the 1990s to the same extent that DOS ruled the 1980s.

However reasonable that may sound, it is not the only possible outcome; it may not even be a *likely* outcome. Perhaps the whole idea of a single dominant operating system is a seriously flawed notion. If it is, then efforts to pick a single winner on which to standardize are not only premature, but also entirely mistaken. If the wave of the future is a plurality of operating systems, requiring all users in an organization to use only one may be misguided.

The prospect of a single winner has, of course, an appealing simplicity. Harried and overworked computer support personnel, especially, are likely to prefer dealing with a single operating system environment to coping with several simultaneously.

Nevertheless, it is by no means obvious that the best interests of the organization as a whole are served by a "one size fits all" approach to a single standard operating system. A plurality of operating environments is more likely not only to better address the realities of the market place, but also to effectively meet the needs of individuals within the organization.

In most organizations of any size, in fact, chances are good that there will be an appropriate place for most, if not all, of the primary OS contenders throughout the 1990s. DOS, various "DOS plus" options, *Microsoft Windows*, OS/2, and Unix—as well as the Apple Macintosh—are all likely to be used in the decade ahead, one way or another, at least in the majority of larger organizations. Even many small concerns will usefully employ more than one operating environment. Each OS has its strengths and weaknesses, and each can contribute by getting necessary jobs done somewhere in the organization.

Despite the proportionally greater attention paid recently to newer alternatives, DOS will continue to be a major player for a long time—certainly well into, if not right through, the 1990s. To begin with, Microsoft continues to improve MS-DOS. These enhancements, coupled with present and future "DOS plus" enhancements from other vendors and competitive alternatives like Digital Research's DR DOS, will certainly extend the useful life of DOS and its derivatives.

This is due in part to the large installed base of older systems that lack the speed, memory, or storage capacity to handle newer, more demanding operating environments. But there are also many users with newer systems who simply prefer the faster execution of non-GUI, character-mode applications.

Windows has been an enormous success since the introduction of *Windows* 3.0, and its user base has grown substantially. Nevertheless, just as many users prefer the familiarity and speed of DOS, many others need or want more than *Windows* has been able to provide,

ILLUSTRATION: DON BAKER

and look toward OS/2 or Unix instead.

With Version 2.0, OS/2 will finally reach the point where it supports a sufficiently wide range of systems and peripherals and, even more important, effectively runs multiple DOS applications. It also supports the complex networked applications and high-speed communications tasks that *Windows*, with its DOS underpinnings, can't handle.

Unix has long been a mainstay of high-end

technical GUI workstations. It is truly the "only game in town" when one seeks a widely available, standard multiuser alternative to proprietary mainframe and minicomputer operating systems. Now Unix is becoming a plausible contender for ordinary office systems, as well.

Even when looking at the era of DOS's "dominance" in the 1980s, one ought not to forget that the Apple Macintosh has long been a strong minority presence. The Mac has sufficient market share to make it at least a part—often a very significant part—of personal computing in the majority of larger organizations as well as in many small companies.

Depending on the needs, history, and background of any given part of an organization, any one or several of these primary OS alternatives may offer the best solution for a particular user or job. Trying to impose one answer, entirely to the exclusion of the others, seldom makes very good business sense.

For the engineering department already familiar with Unix on high-end workstations, one of the Unix operating systems that run on IBM and compatible PCs may be the best bet for office applications. The art (or investment) department, already using Macintosh systems, may be most productive by expanding their Mac use.

For many users, continued use of DOS or one of the DOS alternatives may make sense for a very long time to come. For others, *Windows* or OS/2 may in fact be a better alternative, depending on what they are doing, what they need to do in the future, and what they prefer.

It is unnecessary for any one environment to be the lone winner to the exclusion of all others, for several other, very good reasons: growing availability of individual software titles for multiple operating environments, standard data file formats increasingly transferable across environments, and ever-wider networking capabilities providing communication among computers running different operating systems.

None of this, of course, prevents us from continuing to study and compare operating systems, from speculating on their merits and deficiencies, or from trying to discern relative winners and losers. Though there may not be one clear winner, not all will fare equally well. Some may eventually fall by the wayside.

There is no reason to assume that there must be just one winner in the 1990s among operating systems, in the way that there will be one winner of the World Series in 1991. Keeping that in mind, we are able to consider a wider field of possibilities and, perhaps, to avoid unnecessarily narrowing our options when it makes better sense to use multiple operating systems in running our businesses.

There is no more reason for an organization (or, in some cases, a single user) to limit itself to a single operating system than there is for a carpenter to limit himself to only a hammer to the exclusion of other tools like a screwdriver or a saw. The idea isn't to pick one tool that does everything; the idea is to pick the most appropriate tool for the job at hand. ■

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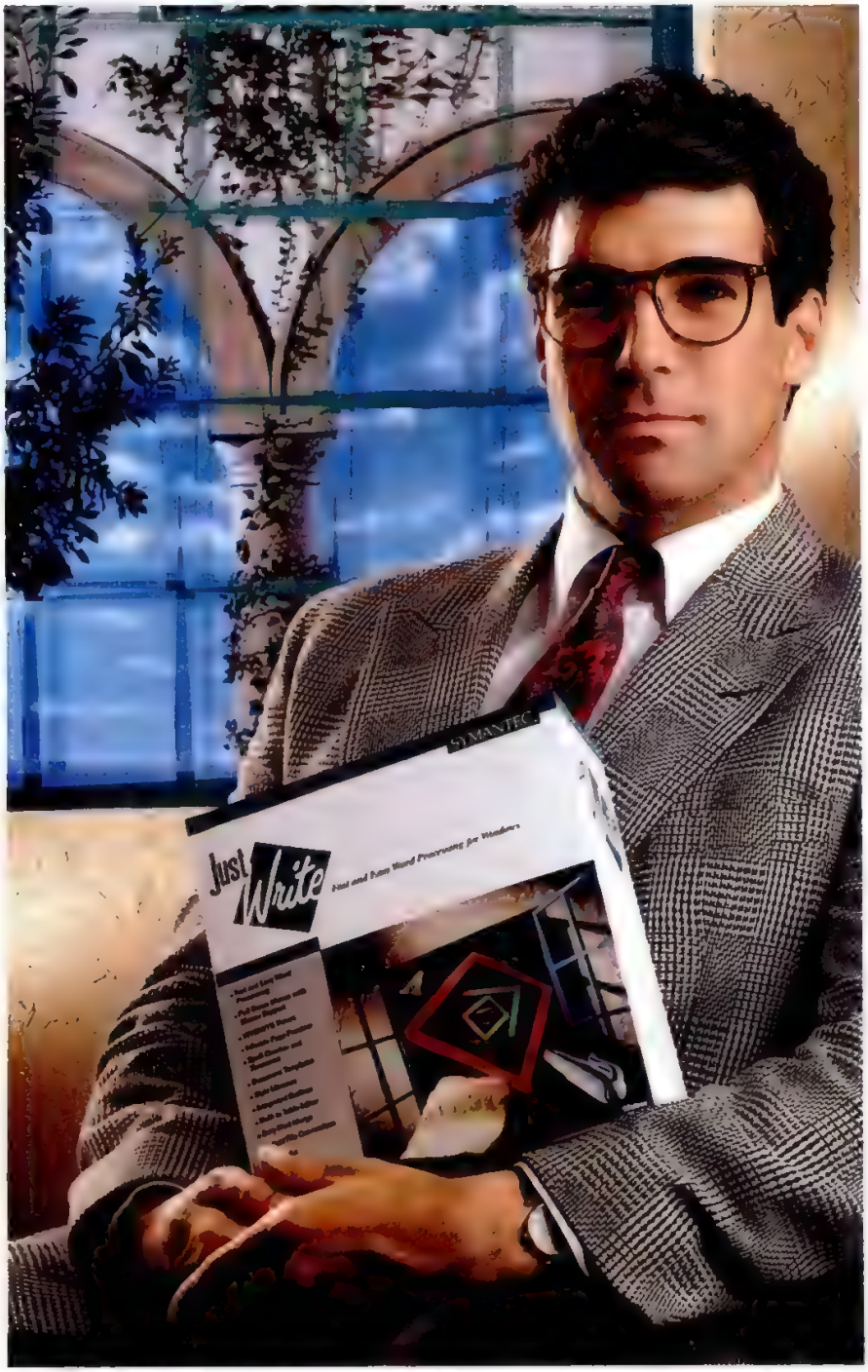

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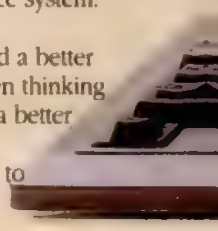

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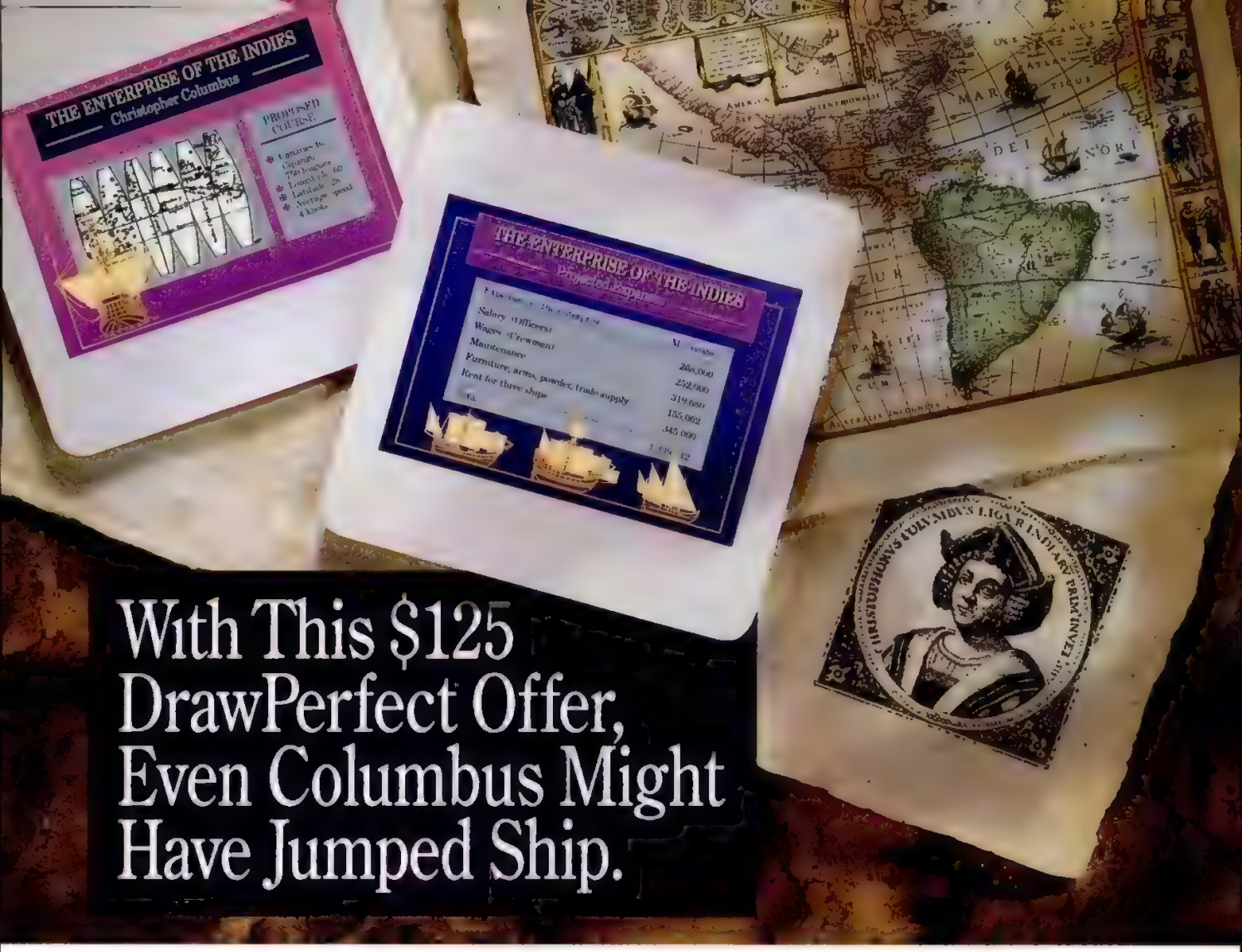

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1,024-by-768 Coprocessed Graphics Adapters:

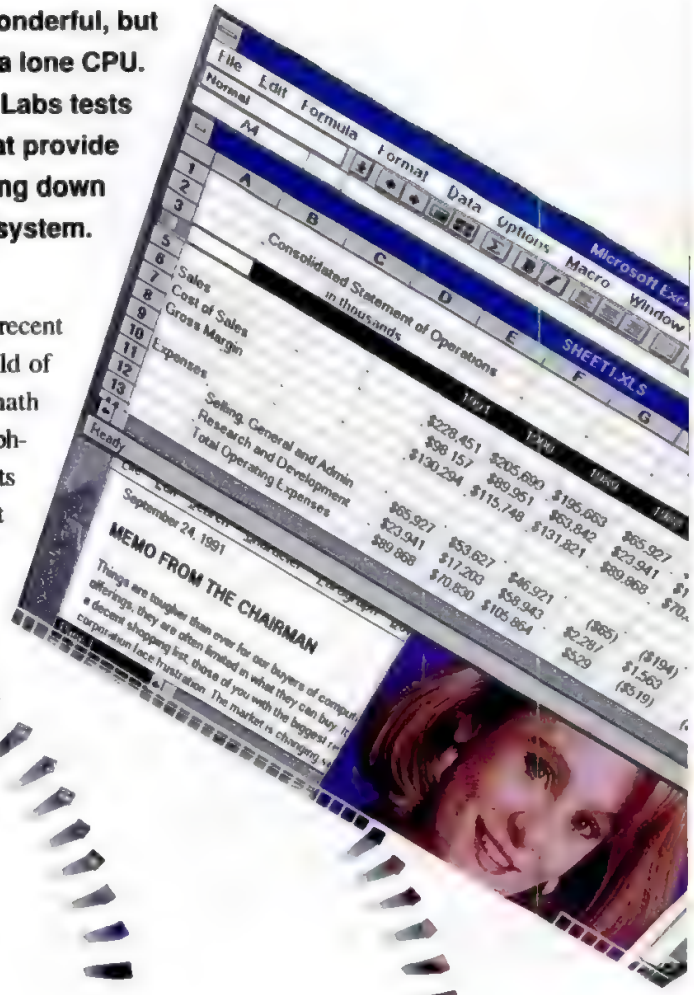
High Resolution And High Speed

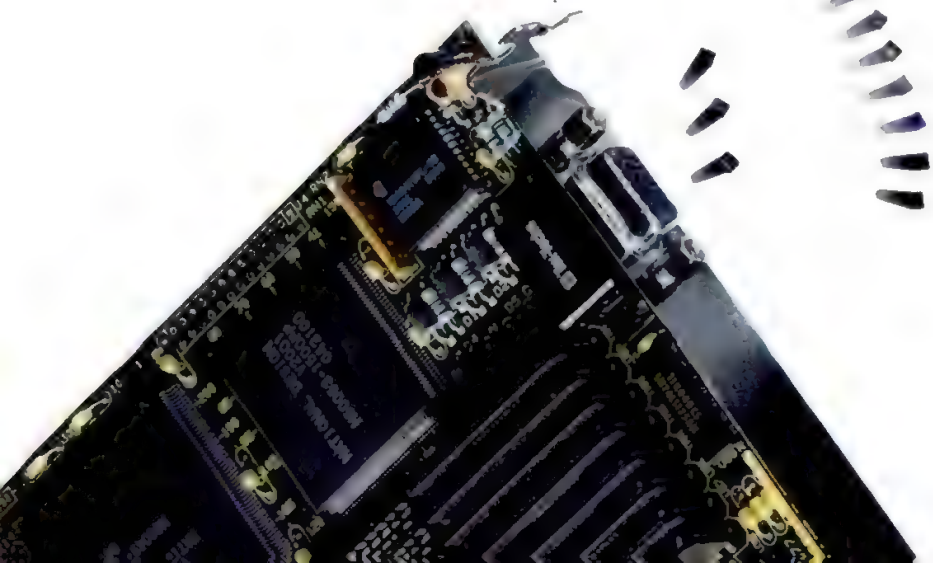
High resolution and lots of colors are wonderful, but all that information can overburden a lone CPU. To bring some relief, PC Magazine Labs tests 15 coprocessed graphics adapters that provide video speed without slowing down the rest of your system.

by Alfred Poor

If one brain is good, two must be better. In recent years, we have seen rapid growth in the field of intelligent expansion devices, from math coprocessors to caching disk controllers to graphics coprocessors. In each case, the extra smarts of the add-on device are there to shoulder part of the load the computer's CPU would otherwise bear. The result is faster performance.

In this article, we look at 15 video boards that offer high resolution (at least 1,024 by 768) and carry graphics





coprocessors—a design that is becoming increasingly important. It should come as little surprise that interest in them is driven in large part by *Microsoft Windows* 3.0.

RISING DEMAND FOR HIGH RESOLUTION

Until now, relatively few users needed fast, high-resolution displays in the range of 1,024 by 768 pixels. Engineers working with CAD programs, graphics artists using high-end drawing packages, and desktop publishers doing micro-based typesetting might need to make use of more than three-quarters of a million pixels at once. These niche markets were addressed by a relatively small handful of expensive proprietary display products.

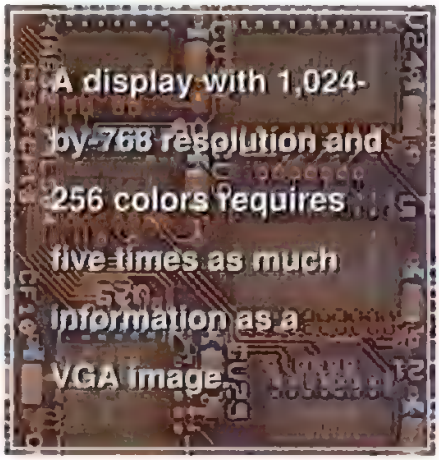
The rest of us dealt mainly with text and a few business graphs and charts. VGA filled this bill well, providing colored text almost as sharp as the original IBM monochrome text display, plus a 640-by-480 graphics mode that offered nearly five times as many pixels and four times as many colors as the old CGA four-color 320-by-200 mode.

Then came *Windows* 3.0, and the picture changed. Sixteen colors are boring; 256-color displays are more lively. VGA resolution is okay, but it limits how much information you can see on a screen at one time. *Windows* is designed to let you work with more than one application, and users are discovering the benefits of seeing the contents of many windows on-screen at once. All these factors add momentum to the move toward higher-resolution displays. The increased demand has helped memory and monitor prices to drop steadily, removing part of the price barrier for higher resolutions.

A QUESTION OF SPEED

The obstacle blocking broad acceptance of high-resolution displays is performance limitations. *Windows* 3.0 already has a well-deserved reputation for taxing most CPUs to their limits. Even standard VGA displays can lack the snappy response under *Windows* that they exhibit with straight DOS applications.

High-resolution displays have to move around much more information than standard VGA, so it stands to reason that performance can suffer. At 1,024-by-768 resolution, the display adapter must track more than 2.5 times as many pixels as in 640-by-480 resolution. And VGA is limited to 16 colors (or only 4 bits per pixel) in its highest-resolution mode, while many high-res displays offer 256 colors (8 bits per pixel). This means that a display with 1,024-by-768 resolution and 256 colors requires five times as much information per image as a standard VGA display. When 1,024-by-768 images with 24-bit color become popular, that amount of information will more than triple.



This extra information slows performance in two important ways. First, the computer's CPU has to work harder computing the contents of all those pixels, which means your application will have to wait longer before the CPU can turn its attention to other operations.

The other bottleneck is what you might call a historical artifact. Most display cards are designed to work in ISA-bus expansion slots, originally introduced in the venerable IBM AT. For a variety of reasons, this 16-bit-wide expansion bus has been held to an operating speed of 8 MHz. As a result, when you use 1,024-by-768 resolution with 256 colors, there is a limit to how fast three-quarters of a million pixels can be squeezed through the bus. (The EISA and Micro Channel buses are designed to make bus transfers wider and faster, but for the moment, display-card manufacturers are still focusing on the more popular ISA bus architecture.)

SPEED STRATEGIES

If you could make the data stream smaller and take some of the load off the CPU, then you could hope for faster display performance. That is the concept behind the design of graphics coprocessor display adapters. Rather than using the computer's CPU to calculate the data for every single pixel in the display's image, the CPU sends the card a set of commands for graphics primitives (the fundamental elements that make up an image—lines, circles, rectangles, and dots); the card's graphics coprocessor interprets these and turns them into a bit image.

For an analogy, consider the difference between how dot matrix printers or plotters draw circles and how PostScript printers do it. For the dot matrix output, the computer must define each dot to be printed, then format and send this data to the printer; depending on the size of the image and the resolution of the printer, this can amount to a flood of data describing the thousands of dots to be defined and transmitted. For a plotter or PostScript printer, the computer merely has to send a command that says, in effect, "Draw a circle with a center at this location, with a radius of this size, and using a line this thick (or, in the case of a plotter, using this pen)." The information can be carried in less than one line of text, reducing the volume of the data stream to a comparative trickle.

Just as different printers use different languages, the various graphics coprocessors each have their own command sets, which vary in complexity and sophistication. Today's crop of 1,024-by-768 graphics adapters basically use two different coprocessor designs; one design is found in the Texas Instruments TMS340*x*0 family, and the other is based on IBM's 8514/A graphics adapter. There are others, such as the Intel i860 design, but these two are most common; they were the only designs that appeared in the 15 boards covered in this review.

Of the two approaches, the processors based on IBM's 8514/A are simpler. IBM's graphics coprocessor has been cloned by a number of chip designers, such as ATI with its Mach 8 chip. The ATI coprocessor's command set contains about 24 instructions, which govern certain simple graphics operations.

By contrast, TI's TMS340*x*0 family of chips are fully programmable coprocessors, capable of operations that are far more complex and flexible. The original TMS34010 is a 32-bit processor (meaning that it handles *internal* calculations with 32-bit speed), and it comes in 40-, 50-, and 60-MHz versions. (Most of the TMS34010-based boards in this review use the 50-MHz version.) The newer TMS34020 chip offers a 32-bit-wide data bus, as opposed to the TMS34010's 16-bit path; it can calculate with 32-bit speed internally and send information to the host CPU the same way. It has twice the

on-chip cache, and it comes in 32-MHz and 40-MHz versions.

According to TI, the TMS34020 can perform up to 50 times as fast as the TMS34010. Both kinds of chips offer a rich command language with more than 85 different instructions for fills, moves, lines, and programming functions—many of which offer a variety of alternative parameters.

One advantage of the TMS340*x*0 family is that boards based on these chips can be designed to respond to TIGA, the Texas Instruments Graphics Architecture software interface. This calls into play the coprocessor's programmable features and makes it possible to design drivers for applications such as *Windows* that are more or less independent of the output device. Tell the board what the capabilities of your monitor are and it will display the highest possible resolution it can for the application, without your computer's CPU having to bother with the resolution.

Which type of design should you buy? The answer is not clear. While many assume that the 8514 standard means only a 1,024-by-768 interlaced display, that is not the case. While IBM's original version does have such a limitation, there is nothing in this standard to preclude a noninterlaced display at the same resolution—as is ably demonstrated by some of the cards in this review.

Performance results present a mixed bag as well. On the one hand are the power and speed of the TMS340*x*0 family, but on the other hand is the smaller instruction set of the 8514-compatible processors, which can be more efficient for some operations. Our benchmark test results show no clear winner between these two approaches, with some of the 8514 designs turning in faster times than some relatively expensive TMS340*x*0 boards.

IS IT COMPATIBLE?

There are also compatibility issues on both sides of the fence. A monitor will not necessarily support all the features of a given card. For example, 800-by-600 resolutions are not part of the 8514-standard definition, and in spite of VESA (the Video Electronics Standards Association), a wide range of signal frequencies are still used to generate these resolutions. Some of the boards do not even offer an 800-by-600 mode at all.

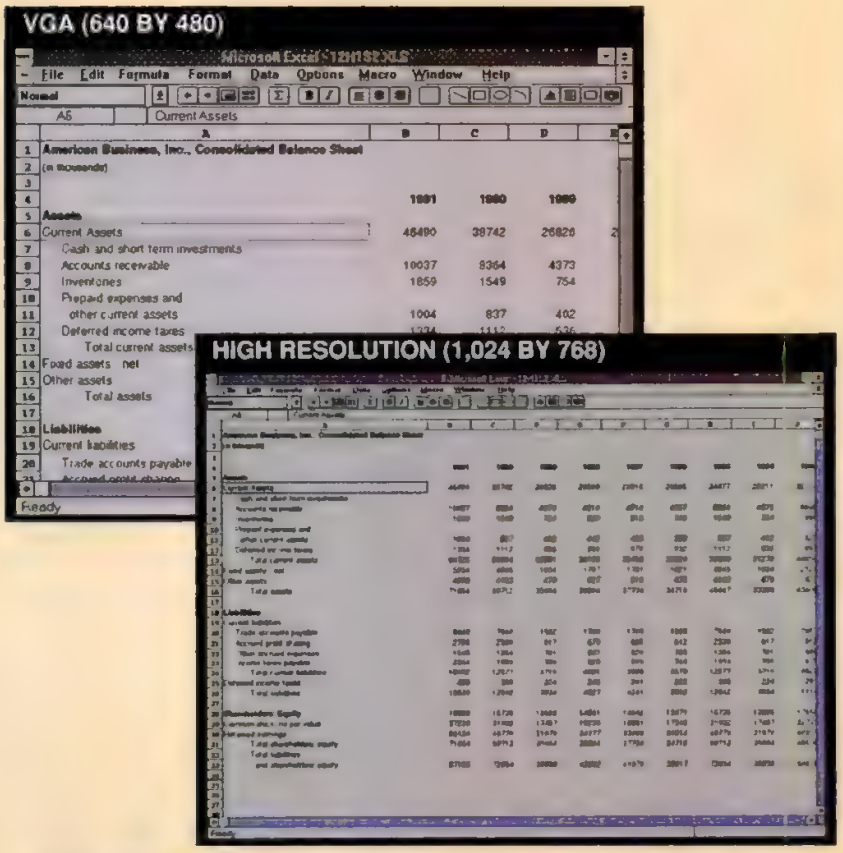
At the 1,024-by-768 level, the 8514 designs have the advantage since the signal's characteristics are defined. The TMS340*x*0 boards tend to offer a range of signals for this higher resolution. Some, like the NEC MultiSync Graphics Engine, can be programmed to match the requirements of a particular monitor, which is a handy feature given the variety of frequencies that different monitors are designed to handle.

The bottom line is to make sure you have a good match between the display adapter under consideration and the monitor you intend to use with it. Verify that the one can produce signals using frequencies the other can handle. This goes beyond just horizontal and vertical scanning frequencies; the actual timing of the sync signals can vary enough to prevent an adapter and monitor from working together even when the frequencies match. Take nothing for granted, and be sure to check carefully before you buy.

Another consideration about the display adapter's signal is the refresh rate, or vertical scan frequency. Many people find that interlaced displays produce annoying flicker. Even noninterlaced images can flicker, however, and this tendency increases as the screen gets larger. According to Jim Anderson of Headland Technology, studies show that the human eye tends to perceive movement more with peripheral vision than with a direct view. This suggests that a bigger screen will intrude more into the user's peripheral vision, where the rapid flicker of the screen's refresh registers as motion.

Many monitor and display-adapter designers reduce flicker by painting more screens per second; that is, increasing the vertical scanning frequency. The typical VGA image uses a 60-Hz vertical scanning frequency; the image is redrawn on

WHAT 1,024 DOES FOR SPREADSHEETS



An image displayed at 1,024 by 768 contains 2.5 times as much information as one at 640 by 480 (assuming the palette sizes are the same). On our test spreadsheet under *Microsoft Excel*, that means the difference between seeing the data as far back as 1984 or just to 1989—and down to line 34 or just to line 20.

THE DESKTOP RAINBOW: True Color at 24 Bits

by M. David Stone

With coprocessed 1,024-by-768 boards now sitting at the expensive edge of mainstream video, it is only natural to ask what the next step is likely to be. Higher resolution is an obvious trend, as demonstrated by Artist Graphics, Hewlett-Packard, Nth Graphics, and other manufacturers in this roundup, whose boards already support 1,280-by-1,024 resolution as a high-end option. But an even more important trend, one that will most likely become widespread because it is less expensive, is greater color capability.

DEEP COLOR

Higher levels of color, starting at 32,768 colors, are collectively called deep color. However, it is useful to draw a distinction between high color (15-bit or 16-bit color) and true color (24-bit color and above). True color offers as many colors as the human eye can detect, so it can display images with photographic-like color quality. High-color images can also display photographic-color quality for many pictures but in some circumstances will yield anomalies. In short, 15- or 16-bit color is often sufficient for apparent true color, but 24-bit color is sometimes necessary for optimal impact.

Until recently, deep color in the DOS world was confined to a few special-purpose applications, such as scientific and medical imaging. They can be invaluable for the designer who uses desktop publishing tools to produce full-color company brochures, for example, but they have no impact on such office staples as word processing and spreadsheets. The special-purpose nature of 24-bit color will likely change as hardware prices fall and 24-bit color software becomes more widely available for applications such as desktop publishing, picture databases, and presentation graphics.

One of the prerequisites for the wider use of 24-bit color in the DOS world was *Microsoft Windows* 3.0. Before *Windows*, there was no widespread deep-color standard for software developers. Indeed, several *Windows* programs, including *CorelDRAW* and *PageMaker*, Version 4.0, now offer 24-bit color support.

Another prerequisite for wider use of 24-bit color was the development of appropriate data-compression schemes. Consider scanning a 5- by 5-inch color picture at 300 by 300 dots per inch and 24-bit color depth. Assuming no compression, that works out to 6.75MB for a bitmapped image. The Joint Photographic Experts Group (JPEG) algorithm has brought file size down by a factor of 20—reducing a 6.75MB file to under 340K—with a claim of no visible loss in image or color quality. If you are williing to accept some degradation in picture quality, JPEG offers compression up to a factor of 200.

EMERGING HARDWARE

With the prerequisites for 24-bit color now falling into place, video board manufacturers are starting to deliver 24-bit color boards. In addition to the Hercules Graphics Station Card GB1024+2 (Hercules Computer Technology, Berkeley, California; 415-540-6000), which is reviewed in this roundup, at least four other manufacturers are currently selling 24-bit color cards or will be by the time this story is published: Everex Systems Inc.'s $795 Everex Viewpoint TC (Fremont, California; 415-498-1111), OPTA's $1,995 MonaLisa (Palo Alto, California; 415-354-1120), and RasterOps Corp.'s $3,995 ColorBoard 1024MC (Santa Clara, California; 408-562-4200).

All four of these boards offer VGA

PC Magazine Labs displayed this scanned color photo using one resolution (640 by 480) but three different palette sizes (24-bit, 8-bit, and 4-bit).

The closest you can get to photo-realism is to use a 24-bit color board, which provides a palette of 16.7 million colors and produces our test image beautifully.

support, either on-board or, in the case of the RasterOps ColorBoard 1024MC, in the form of a VGA pass-through. By the time you read this, all four should include a *Windows* 3.0 24-bit color driver. OPTA's MonaLisa will also include a $900 option, complete with a hardware implementation of the JPEG compression algorithm, a SCSI port, and drivers for popular scanners.

On some cards, the 24-bit color is limited to relatively low spatial resolutions. The Hercules Graphics Station Card GB1024+2 offers 24-bit color at 512-by-480 resolution only. Be aware also that the human perceptual system interprets true-color images as having a higher resolution than images with fewer colors at the same resolution. As of this writing, the Hercules card comes in two versions: a $1,024 version with 1MB of VRAM, and a $1,495 version with 1MB VRAM plus 2MB of DRAM. (See the review for more details.)

The Everex Viewpoint TC provides somewhat better resolution and more choices in color depth than the Hercules card, with standard VGA, 15-bit or 24-bit color at 640 by 480, 8-bit color at 800 by 600 and 1,024 by 768, and 4-bit color at 1,280 by 1,024. The OPTA MonaLisa provides true color at still greater resolution, with standard VGA, plus 8-bit, 16-bit, or 24-bit color available at 640 by 480, 800 by 600, and 1,024 by 768. The RasterOps ColorBoard 1024MC offers 24-bit color at 1,024-by-768 resolution only. Its high price is partly explained by the 3MB of VRAM on-board.

SMALLER STEPS

Between the reality of today's 8-bit color and the future of inexpensive 24-bit color lie some intermediate steps that promise to be more affordable. In particular, there are two digital-to-analog (DAC) chips worth mentioning: the 32,768 HiColor Palette chip from Sierra Semiconductor and the Continuous Edge Graphic DAC (CEG/DAC) from Edsun Laboratories.

Both of these chips are enhancements to standard Super VGA boards. They replace the existing DACs and require little or no change to the boards. Appropriate drivers are generally supplied with the boards.

As its name implies, the 32,768 HiColor Palette chip ups the number of displayable colors for a video board to 32,768. (By the time this is published, Sierra expects to have a 16-bit 65,536-color chip available.)

The Edsun chip also ups the number of displayable colors (to 740,000), but its real advantage is its anti-aliasing feature—the ability to smooth out the jagged edges of diagonal lines. Anti-aliasing mixes background and foreground colors for pixels that lie on the edge of a line, fooling the eye into seeing a smoother line. The result is less-jagged lines for CAD and desktop publishing. The Edsun chip is also a good choice for photo databases, but it remains a questionable choice for applications where you need to edit the image because of the overhead involved in recalculating anti-aliasing codes.

The difference in capabilities between the Edsun and Sierra chips is so great that at least one board manufacturer, Icon Technologies International (Charlottesville, Virginia; 804-977-1551), will be selling one board with each chip. Both boards should be shipping by the time you read this.

Most observers agree that the current Sierra chip and Edsun chip represent a bridge between current standards and 24-bit color of the future. The one sure conclusion is that thanks to these chips, even the immediate future looks far more colorful for PC users. ■

Your next-best choice is to go with a palette of 256 colors (at 640 by 480 here, but the image would look similar at 1,024 by 768). The quality is acceptable but not great.

With standard VGA's palette of 16 colors, the image is not acceptable. Compared with the 24-bit color image, VGA looks like dot matrix output next to laser output.

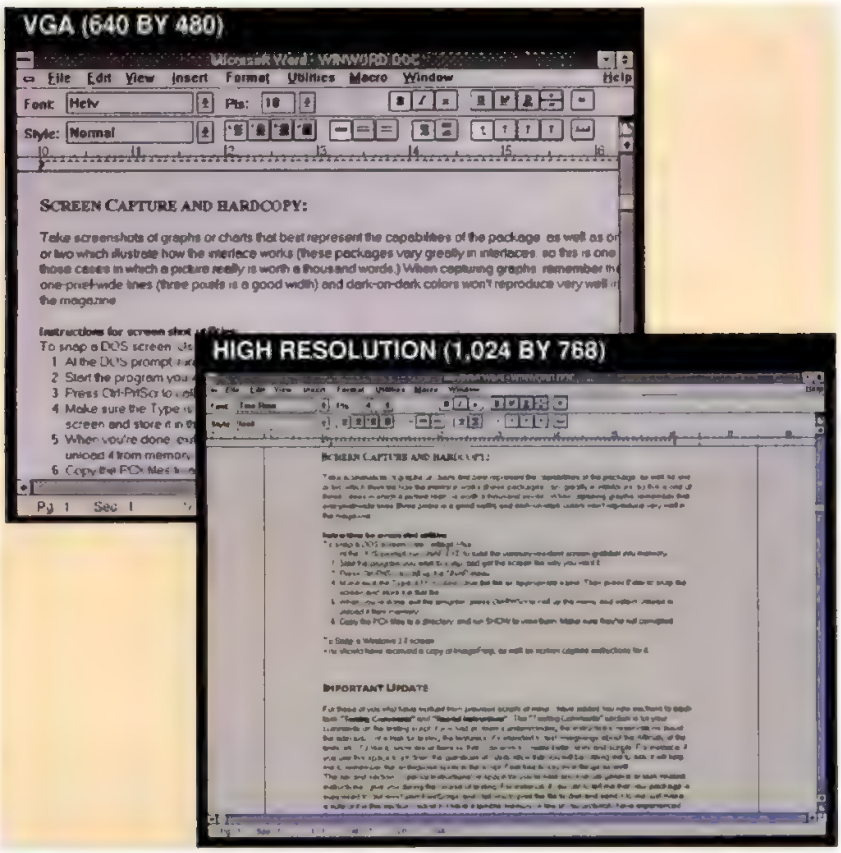
the screen 60 times per second. Some high-resolution adapters use lower rates—some as low as 43 Hz for 1,024-by-768 interlaced, and 56 Hz for some 800-by-600 images. The trend is toward higher rates, however, to reduce flicker. Many boards offer a 70-Hz vertical scanning frequency, and the new VESA standard calls for 72 Hz for 800-by-600 modes. Again, be sure your monitor will work with the board you might purchase.

Then there is the question of software compatibility. Many software programs now have support for the 8514 display standard built-in, while for most TMS340x0 boards, you must still rely on the manufacturer to supply a driver for high-resolution modes. The 8514 advantage is not as great as it might first appear, however, since some 8514-compatible board makers prefer to provide their own drivers to get better performance or to take advantage of extended features built into the board; the ATI 8514/Ultra is an example of this practice.

Moreover, certain programs provide direct support for TMS340x0 boards that support a graphics controller language. For example, the NEC MultiSync Graphics Engine has a driver that provides support for DGIS (Direct Graphics Interface Standard), which in turn is supported by a wide range of programs, from CAD applications to graphics packages such as *Harvard Graphics* to word processing programs like *WordPerfect*. Some TMS-340x0 boards rely on the TIGA interface, which is also gaining direct support from applications. According to a Microsoft representative, driver support for TIGA will be included in a future release of *Windows*, and it may be made available even sooner through a Supplemental Driver Kit (SDK).

You have to make certain that the board comes with the drivers you need for your applications, or that it will work with a driver included with your software.

WHAT 1,024 DOES FOR DOCUMENTS



VGA mode makes our test document—with its 65-character lines—virtually unreadable in *Microsoft Word for Windows*, because the margins are cut out entirely and some of the characters are chopped off. Working in high-resolution mode gives the document healthy margins, dramatically improving its readability.

COST CONCERNS

Once all the compatibility problems are ironed out, you have to take your board up to the cash register. 8514-based designs are simpler and closer to existing VGA designs, making them less expensive to produce. The 8514 cards in this review range in list price from $799 to $1,695. The low end of the 8514 market is destined to get even lower; by early this summer, you can expect to see 8514 cards (with VGA) that have list prices under $500, which means anticipated street prices as low as $330. Given the growing acceptance of 8514 as a new high-resolution standard, built right into applications such as *Windows* 3.0 and many CAD programs, these boards present an appealing price/performance value.

To be sure, the average TMS340x0 board costs more. Base prices range from $695 to over $3,000, and many of these boards do not include VGA compatibility. In many cases you must either purchase an additional daughterboard or rely on an existing VGA adapter to pass the signal through to the TMS340x0 board. It will be a long time before our PCs boot up into anything other than a typical DOS text mode; you can expect that VGA text modes will be required for most desktop systems for the foreseeable future. Still, since many users may be installing the reviewed boards as upgrades to existing systems that already have VGA adapters, the extra cost may not be a factor.

Furthermore, the price of TMS340x0 boards is dropping fast. Many of the relatively expensive boards are older designs, from companies that specialize in serving the niche markets of CAD and other graphics areas. The broader market of users is not as likely to be willing to pay a high premium for high-performance graphics, and a number of companies are already responding with lower-price offerings. Appian Technology has announced a 16-color 1,024-by-768 noninterlaced TMS 34010 board for a list price of $695 (and you can get 256 colors with an optional memory upgrade). This does not include VGA, which is available on a daughtercard or via pass-through from an adapter already installed in the computer. With

prices like this, the savings that 8514-based designs offer look rather small.

While the boards reviewed here represent some of the fastest high-resolution displays available, alternative approaches are on the horizon.

One such design is IBM's new XGA coprocessed graphics adapter. With a more powerful coprocessor and larger command set than the 8514 it replaces, XGA promises to be better suited for applications like *Windows*. It is also designed to run faster and to take better advantage of high-tech performance approaches such as bus mastering. XGA is specified to use either a 16-bit or 32-bit data bus; you'll need a 386DX or better to take advantage of this feature, but it could translate into faster displays. Critics of XGA point out that the new cards will be expensive to design and build, and that acceptance by software developers and buyers may be slow. We may be as much as a year away from XGA's arrival as a significant factor in the display market.

UNCORK THE 16-BIT BOTTLENECK

Another new approach is to solve the display performance bottleneck without a coprocessor. Proponents of this plan argue that today's faster CPUs have cycles to spare, and the real slowdown occurs when you try to send all the pixel data across a slow and narrow 8-MHz 16-bit data bus. Take the existing VGA and Super VGA technology, hook it up to the 33-MHz 32-bit-wide system bus of a 386/33 system, and you will see an enormous performance boost—four to eight times as fast. The technology is relatively simple to create, and adding it to a motherboard should cost little or no more than typical on-board VGA costs now. (Current motherboard VGA designs hook the display adapter circuitry to the expansion bus, not the CPU system bus, which is why you don't see much difference between expansion card VGA and motherboard VGA performance figures.)

The same concept can be taken one step further. Graphics coprocessor advocates point out that these chips can be put on the system bus just as easily as VGA or Super VGA circuits can, but offering the additional speed advantages of coprocessed display adapter technology. Wire in a fast processor like a TMS34020 or an XGA-compatible design directly to the CPU and you should see incredible performance.

Yet some manufacturers, such as ATI, expect that most of the market will still want video adapters on expansion boards. These companies favor a strategy that takes affordable technology, such as 8514, and builds extra value into the package. For example, the ATI board includes Crystal Fonts technology, which provides anti-aliasing for text on-screen. This alters the shade of pixels on curved or angled lines to smooth out the stair-step jaggies, giving the impression of smoother text and a higher-resolution display. Other new boards, such as Galaxy-III from Portacom Technologies (San Jose, California; 408-

PC MAGAZINE EDITORS' CHOICE

- **ATI 8514/Ultra**
- **National Volante AT1000**

High-resolution adapters capable of producing more colors are in demand. With *Microsoft Windows* 3.0 providing support for the 8514/A standard, software manufacturers and consumers alike are looking to high-resolution power to spruce up applications such as presentation and photo-imaging software, and even picture databases.

The only problem is performance. To produce a 256-color 1,024-by-768 picture, the CPU must process nine times as much information as a standard 16-color VGA image. This overhead can severely cripple the speed of most machines. Enter the graphics coprocessor. Usually based on Texas Instruments' TMS340x0 chip family or proprietary 8514 work-alikes, graphics coprocessors will let you run high-resolution images without causing your CPU to slow down.

Of the 15 noninterlaced 1,024-by-768 coprocessed graphics adapters reviewed, the standout winner is the ATI 8514/Ultra, based on ATI's own version of the 8514 coprocessor. Using its own driver instead of the *Windows*-supplied one, this board ripped through our *Windows* tests and also did respectably on the *AutoCAD* exams. Furthermore, it comes with proprietary anti-aliasing technology (called Crystal Fonts) that makes on-screen high-resolution text much easier to read. The 8514/Ultra performed its high-end duties excellently—for one of the best prices around ($799 for the 1MB tested version). You will, however, have to rely on pass-through technology to get down to VGA resolution.

Close on the heels of the ATI 8514/Ultra is the National Volante AT1000 from National Design. The card, based on a 32-MHz TI TMS34020 chip, did very respectably on the *Windows* and *AutoCAD* test suites, showing exceptional speeds during the *AutoCAD* redraw and regeneration regimens. It truly shone on the VGA compatibility tests, because of its on-board Tseng Laboratories VGA controller. The Volante was the only board to beat the performance of our test-bed Compaq Deskpro 386/25e's built-in VGA circuitry, which equates with the performance you would get from any quality VGA controller. Plus, its price is strongly competitive—only $995 including 512K of frame-buffering VRAM and 1MB of DRAM. If you want high-end resolution with on-board VGA capability, this is the best choice.

An honorable mention goes to the Hercules Graphics Station Card GB1024+2. Based on TI's 60-MHz TMS34010 coprocessor, the Graphics Station Card is able to show true 24-bit color at 512-by-480 resolution as well as 256 colors at 1,024 by 768. Its on-board VGA circuitry made it one of the fastest adapters we looked at, and its high-resolution performance under *Windows* and *AutoCAD* was respectable. With broad-ranging abilities and the backing of a proven market leader, the Graphics Station Card won't steer you wrong.

As a group, the boards will deliver solid high-end performance without speed degradation. In general, their VGA performance is noticeably below that of a dedicated VGA controller, but it is adequate for occasional use. The only product we felt really trailed the field was Desktop Computing's AGA 1024.

428-1800), are using Edsun Laboratories' new CEG (continuous-edge graphics) chip to provide a similar effect.

Another imminent development is the production of 16-bit cards that are nearly as fast as coprocessed cards but are not coprocessed. These cards deal with the problems of video memory bottlenecks through use of a 32-bit port to video RAM (VRAM).

While testing the coprocessed boards for this article, we examined an experimental card based on a video chip set and BIOS developed by Chips and Technologies Inc. This 16-bit card came with 1MB of VRAM. While the price tags of the coprocessed boards tested here start at $695, the VRAM boards based on this chip set and others from different vendors, such as Tseng Laboratories, should roughly halve that cost.

Chips and Technologies' experimental card performed well against the coprocessed cards and, at 1,024-by-768 resolution with 256 colors, made quite a good showing on our VGA benchmark tests. On the *Windows* tests, the experimental card proved slower than the coprocessed cards but still surpassed the slowest scores in each category. The experimental card was still in the back of the pack on our *AutoCAD* tests, too. But since the cards based on this and other VRAM chips should sell for under $300, you may consider waiting.

REVIEW CRITERIA

Right now, if you want a 1,024-by-768 display adapter with a graphics coprocessor, your choices are limited to the expansion boards covered in this review. To be included, these boards had to offer support for 1,024-by-768 noninterlaced display modes, a hardware graphics coprocessor, a 16-bit ISA expansion bus interface, and support for VGA—either on-board with a daughtercard, or via a VGA passthrough connector.

Fifteen display adapters fit these selection criteria. These included products from ADEX, Appian, Artist Graphics, ATI, Desktop Computing, Hercules, Hewlett-Packard, National Design, Nth Graphics, NEC, Rasterex, SOTA, Spectragraphics, Vermont Microsystems, and Western Digital Imaging.

Other boards were excluded for a variety of reasons. Number Nine Computer Corp.'s #9GX arrived at PC Magazine Labs with a faulty driver, and the company was unable to ship a working one in time for review. Liberty Electronics' VGS-20, which was inoperable on arrival, is a duplicate of the National Volante AT1000 from National Design. ELSA America's Gemini/10 and Enertronics Research's Aurora 1024N did not reach us in time for this review.

The boards that remain present an interesting range of features and performance results. Note that quality does not always correlate with price; some of these boards represent significantly better values than their competition.

If you are hooked on *Windows*, or if you work with precise graphics applications such as CAD or desktop publishing, take a look at the following products. You may be surprised to find that a high-resolution display can be fast as well as finely detailed.

WHAT 1,024 DOES FOR DTP PAGES

Working in VGA with Aldus' *PageMaker* means seeing only 60 percent of our desktop publishing test page. Going to high-resolution mode lets you see the whole page, including parts that were missing in VGA, such as the rest of the illustration, all of the third column of text, and the margins (or "gutters").

ADEX CORP.

ADEX 8514/AT256

by Winn L. Rosch

The $1,299 ADEX 8514/AT256 is a specialist—a pass-through–only board that is hardware-compatible with IBM's 8514/A standard. Though there are faster and cheaper 8514/A-compatible boards on the market, the ADEX delivers a sharp stable image and puts its IBM original to shame when it comes to speed.

Based on the Western Digital Paradise WD9500 VLSI chip coupled with 1MB of nonexpandable VRAM as standard equipment, the ADEX 8514/AT256 adds some major improvements to its IBM prototype. Its top resolution is 1,024 by 768 noninterlaced, and the ADEX also offers

Once again, editors rave about the Tangent 486.

"...when the full 16 stations included in the test were active. The Tangent Multi-Server 433e was still the fastest..."
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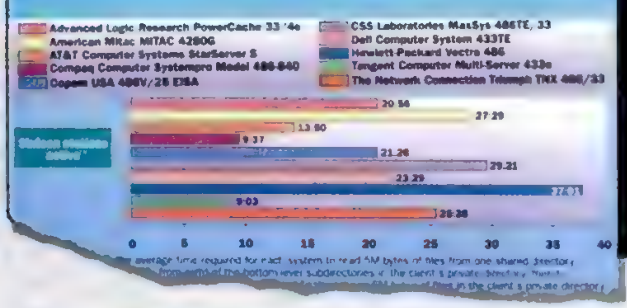
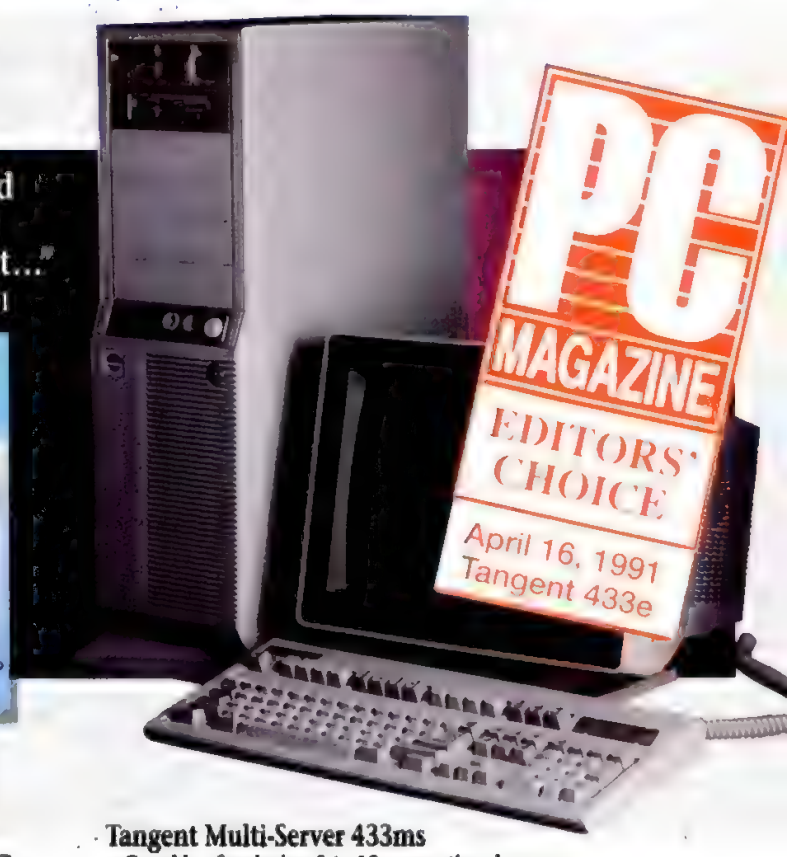
PC WEEK

Tangent Server Maintains Performance Lead As LAN Size Increases





"A consistently strong performer across all tests, the Tangent model 433e stands out in this group." PC Magazine April 16, 1991

PC MAGAZINE EDITORS' CHOICE
April 16, 1991
Tangent 433e

PC Magazine, April 16,1991

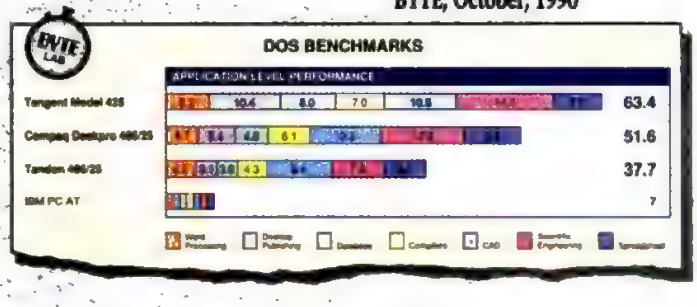
TANGENT COMPUTER INC.

Tangent Model 433e

by Bill O'Brien

Tangent Computer's foray into the realm of the EISA bus is represented by an investment-quality machine.

"The big winner is the Tangent..."
BYTE, October, 1990



When the editors got through writing about Tangent 80486 systems, they didn't leave us a lot to say. Except price. First, compare performance. Then compare price. What you'll see is that Tangent is the price-to-performance leader in 486 systems, with a range of models designed to fit any need.

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a choice of 60- or 70-Hz vertical refresh rates (special-order variants allow frame rates up to 76 Hz to match European standards). Physically, the ADEX also goes where IBM refuses to tread: For the same price, you can get an ISA or Micro Channel version that slides directly into a standard 16-bit expansion slot.

Setting up the board requires little more than selecting the vertical scanning frequency to match either 60-Hz interlaced or noninterlaced displays. If you need to alter the base address of the board's ROM, you do so by using a DIP switch accessible through the card's rear-panel retaining bracket. Jumpers let you select the board's interrupt and adjust its bus timing to match the IBM AT standard or that used by NEC 80386-based computers.

Like IBM's original 8514/A board, the ADEX supports only high-resolution modes, requiring separate VGA circuitry to support DOS text modes and VGA graphics. The company supplies a short 8-inch cable to connect the board with a standard VGA feature connector for single-monitor use; the ADEX will also operate in a two-monitor configuration. It is compatible with the IBM product at both the application program interface and register levels, so it works flawlessly with Microsoft's 8514/A driver for *Microsoft Windows* 3.0. The company also supplies a Western Digital application interface driver for compatibility with the 8514/A application interface and Western Digital's TwinFocus display-list driver for *AutoCAD*, Release 10. A driver for *AutoCAD* 11 is not yet available.

The ADEX 8514/AT256 won't race through *AutoCAD* or *Windows* 3.0 like a board with a TI graphics coprocessor, but it is almost three times as fast as IBM's 8514/A as well as easy to install and use. While neither the fastest nor highest-resolution board around, its excellent 8514/A compatibility delivers a quality image without hassles.

FACT FILE

ADEX 8514/AT256
ADEX Corp., 1750 Junction Ave., San Jose, CA 95112; 408-436-9700.
List Price: With 1MB VRAM, $1,299.
In Short: Though it is not a price or performance standout, the 8514/AT256 delivers a quality image and solid performance with few hassles.

CIRCLE 612 ON READER SERVICE CARD

APPIAN TECHNOLOGY INC.

Appian Rendition II

by Alfred Poor

The name Appian, which is the latest corporate moniker for the company formerly called Zymos (and before that, Renaissance GRX), may be unfamiliar to you. But its Rendition II, which won our Editors' Choice designation last year (*PC Magazine*, April 10, 1990), is no newcomer to the high-resolution graphics market. Priced at $995 for the base model (capable of 1,024-by-768 noninterlaced resolution with 16 colors) or $1,445 for a fully expanded version (which includes a VGA daughtercard and additional memory to support 256 colors in the 1,024-by-768 display mode), the Rendition II is best described today as a solid but not flashy performer.

Installing the Rendition II is uneventful. You insert it in either an 8-bit or 16-bit slot, then configure it to use 8-bit memory operations, even in a 16-bit slot (a handy option if you are trying to resolve conflicts with other boards, such as LAN adapters). The instructions for hardware and software installation are straightforward and relatively easy to follow. If that fails, Appian's technical support proved as good as its documentation; an adviser patiently helped us trace a problem we encountered when running *AutoCAD* to an incompatibility in the memory map of our test-bed Compaq Deskpro 386/25e, and then helped us relocate the board's addresses to resolve the situation.

The board supports TIGA, and Appian provides drivers for many popular programs, including both real-mode and protected-mode drivers for *AutoCAD* 10 and *AutoCAD* 11. Its *Microsoft Windows* 3.0 driver has an interesting feature worth noting: When you install it through the *Windows* SETUP program, you are offered a choice between a high-resolution driver for 800-by-600 and higher resolutions and a low-resolution driver for 640-by-480 resolution. You can actually use either driver in any of the resolutions supported by the card; the difference is that you get somewhat larger icons and characters with the low-resolution driver, which lets you use 1,024-by-768 resolution on a 14-inch monitor and still read your screen.

FACT FILE

Appian Rendition II
Appian Technology Inc., 2405 140th Ave. NE, Bellevue, WA 98005; 800-422-7369, 206-454-8086.
List Price: With 1MB VRAM, $1,295. VGA daughtercard, $150; separate VGA cards, $149 and $249.
In Short: The Rendition II, based around a 50-MHz TI TMS34010, delivers quality performance, but still not great enough to distinguish it clearly from the rest. If its price were lower, it might be more attractive.

CIRCLE 613 ON READER SERVICE CARD

The board is powered by a 50-MHz Texas Instruments TMS34010 graphics coprocessor. Though its speed was on a par with most of the other boards in the *AutoCAD* tests, it rated slower than average for the *Windows* tests. The Rendition II's VGA daughtercard did well on the VGA compatibility tests, but its VGA speeds were only fair. You can of course use the Rendition II's pass-through feature to accept the signal from an external VGA adapter that may be faster.

The Rendition II would be more attractive in today's market if its price were lower or its performance hotter. As we began testing, Appian announced a new board, the Graphics Vision 1024, which has similar specifications but at a more competitive list price of $695. For the moment, though, the Rendition II represents a good combination of reliable design and quality support, but it isn't the standout it once was.

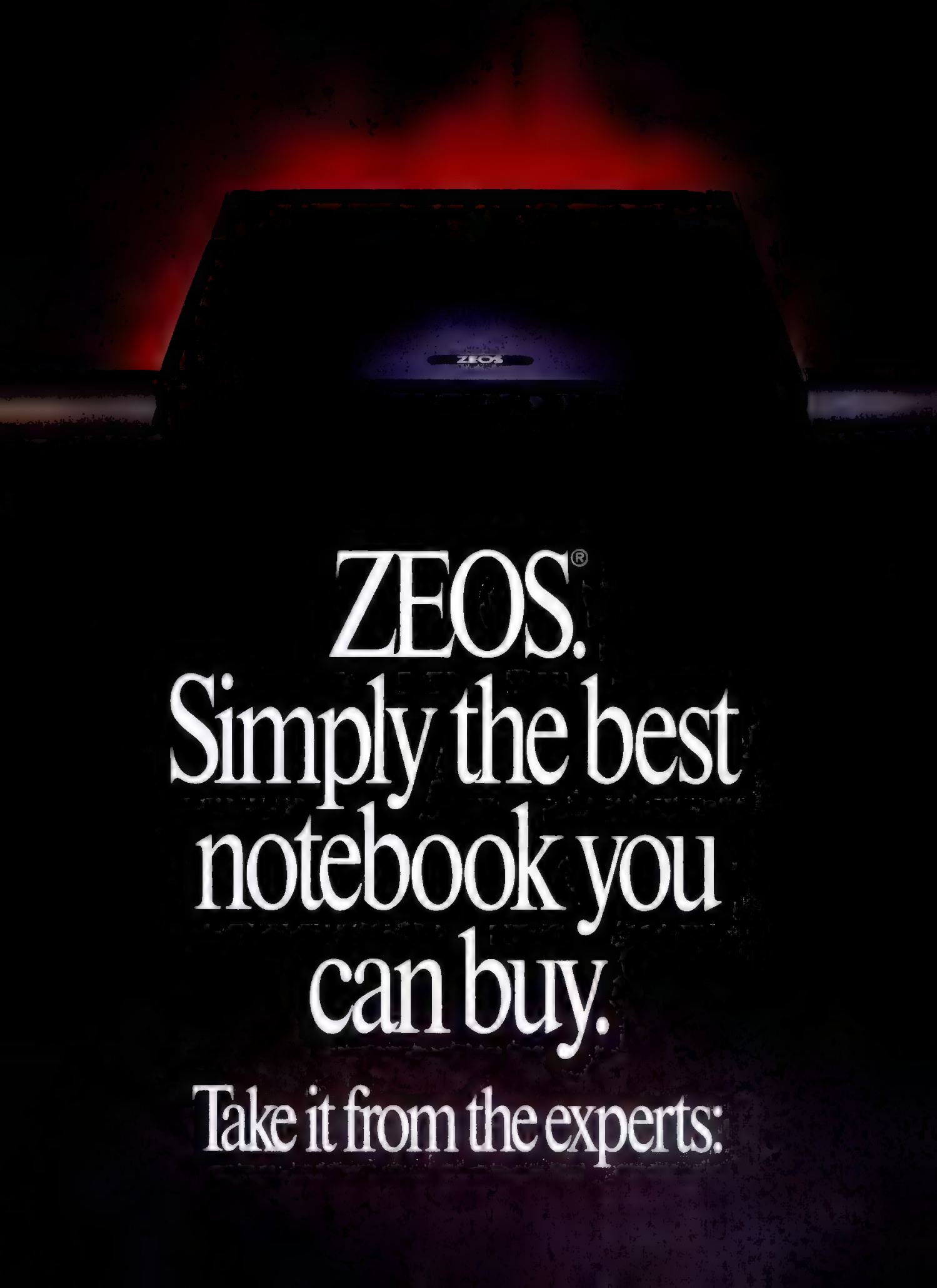
ARTIST GRAPHICS

Artist XJS-1024

by Winn L. Rosch

No ordinary graphics adapter, the Artist XJS-1024 from Artist Graphics, a division of Control Systems, pushes resolution all the way up to 1,280 by 1,024 pixels. In fact, the $3,295 board pushes so hard that it's reluctant to stoop down to some multiscanning monitors, even when displaying VGA images through its optional daughtercard. Only with reluctance did the XJS-1024 condescend to work with the Sony 1304 monitor used in PC Magazine Labs's test system; this board likes to do its work on big screens and with a wide bandwidth.

The keynote of the Artist Graphics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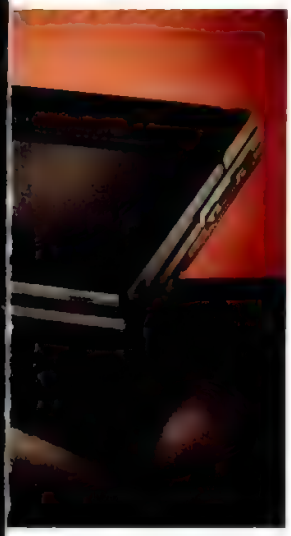

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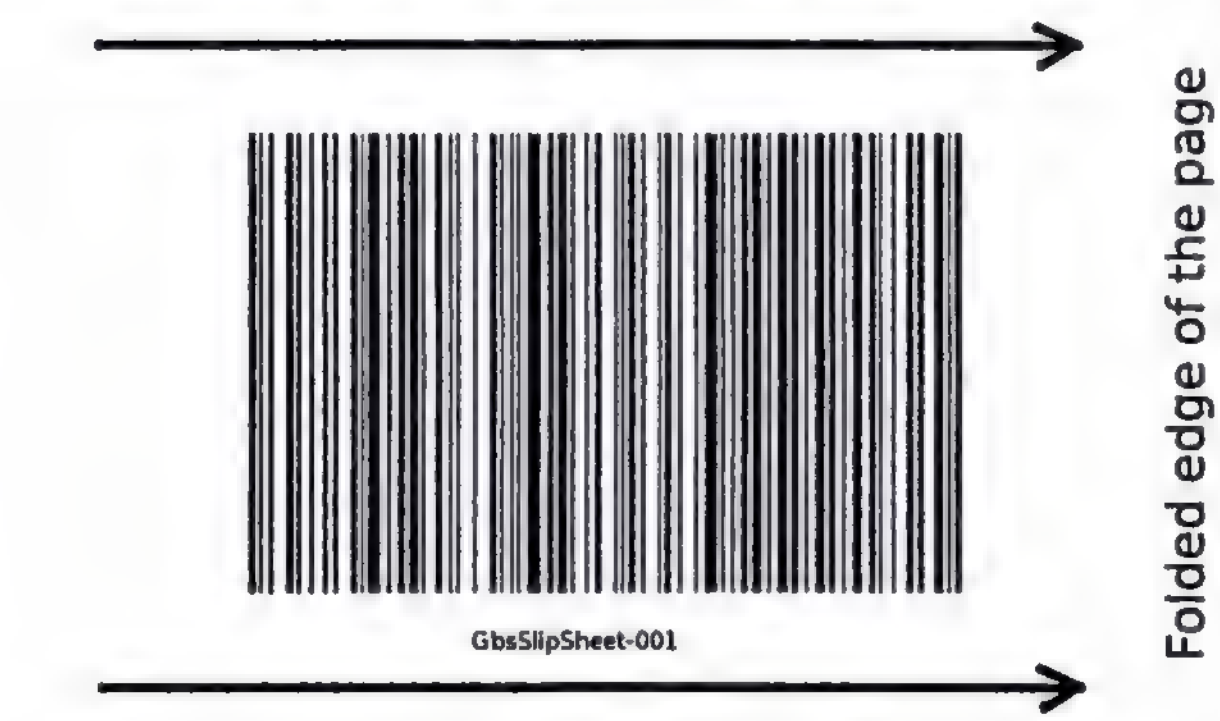

Foldout slip-sheet

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2. Insert this sheet with
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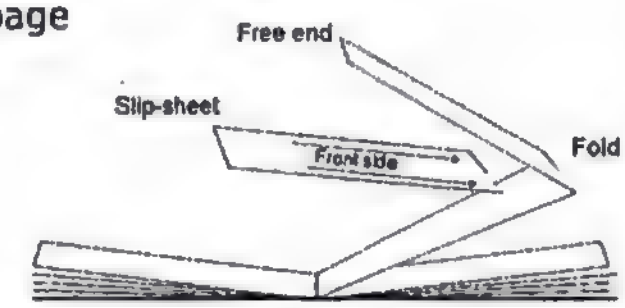
3. Slice the folded edge
4. Close the page and slip-sheet



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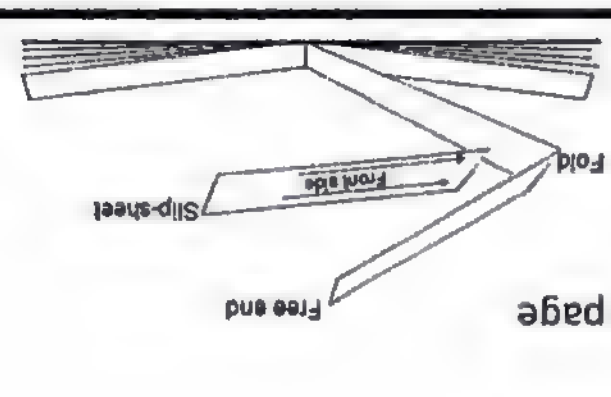

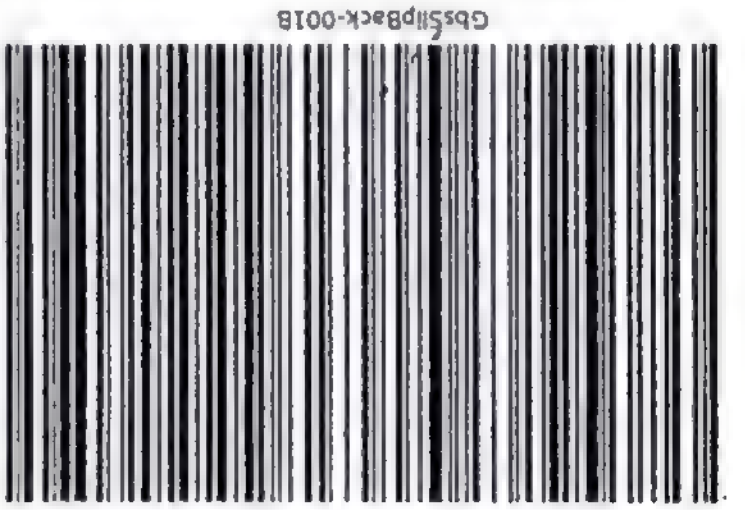

Back

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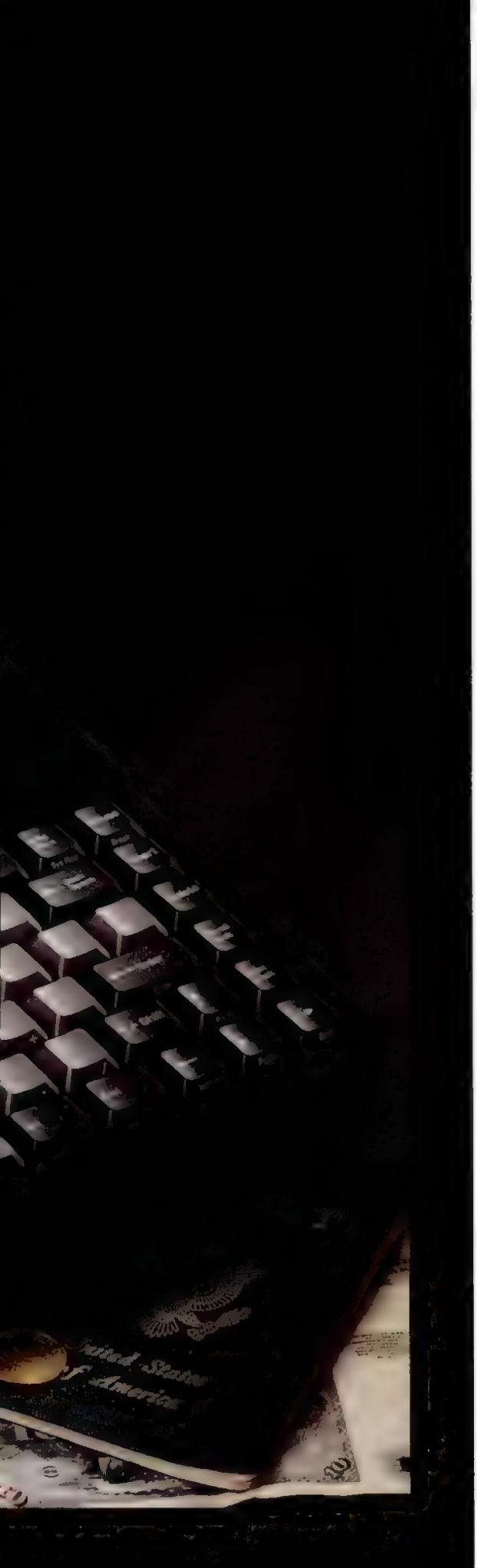
Inverted Back

1. Follow instructions on the other side



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While most notebooks don't include a floppy drive at all, you're really going to appreciate your ZEOS notebook's industry standard 3.5" floppy. It makes loading software and transferring files a breeze. Simply toss in your 1.44 and it's done. Anyway, can you imagine a desktop system without a floppy? We couldn't either. That's why your ZEOS notebook has one. It's great!

But the features of your incredible new ZEOS Notebook don't just stop there. Detail after detail we're giving you more than anyone else. Much more, for much less. Take a closer look.

DETAILS MAKE THE DIFFERENCE!

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10 Good Reasons To Buy From ZEOS®

Reason #1

"Overall Excellence."

As *PC Magazine* said "Price is always a consideration. So are benchmark test results. But both factors can be deceiving, which is why we consider them in the context of other aspects that will make the difference months and years down the road."

These are the attributes which *PC Magazine* used in awarding ZEOS the coveted Editor's Choice, not once but *seven* times. And "Overall Excellence" are the very words *PC Magazine* used in describing ZEOS systems comparing them to all others.

Reason #2

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In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

Dazzling Performance is built into every ZEOS system. It's a key component of ZEOS Overall Excellence.

Reason #3

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PC Resource Magazine put it this way, "ZEOS... provides quality comparable with IBM or Compaq and does so for about 70% of the price." ZEOS uses only the very best components. And every system is fully tested and burned-in right in our own labs.

Reason #4

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InfoWorld says, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent." *Personal Computing* said, "ZEOS... is the best value we've come across... its performance is right up there with the slickest, most expensive PCs you can buy."

Reason #5

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Since? (Mo./Yr.) _____ ☐ Buy ☐ Rent ☐ Other _____

Previous Address _____

City _____ State _____ Zip _____

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_____ Relationship _____

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Savings Account ☐ Yes ☐ No

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VISA	___	_____	Credit Union Account	___	_____
MasterCard	___	_____	Other Major Charge Cards	___	_____
Finance Company Loan	___	_____			

C. JOINT APPLICANT INFORMATION

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Bus. Phone (_____) _____ Monthly Gross Salary $ _____

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CIRCLE 115 ON READER SERVICE CARD

design is versatility. Built around a 32-MHz TI TMS34020 graphics coprocessor, the XJS-1024 is only nominally a 1,024-by-768 product. With programming it will work backwards to 800 by 600 pixels, or with additional circuitry for resolution and more RAM for colors, forwards to 1,280 by 1,024 pixels. Its palette spans a spectrum of 16.7 million hues, with 256 of those colors simultaneously displayable in all but its highest resolution modes. The base-priced XJS-1024 unit comes coupled with 1MB of VRAM and 1MB of DRAM for display-list processing. A $795 expansion module pushes VRAM up to 2MB, while you can extend the DRAM by filling the four sockets on the board with standard 80- or 100-nanosecond SIMMs.

The XJS-1024 offers two avenues to VGA.. The optional single-slot Artist Graphics VGA daughtercard ($595) adds VGA capabilities directly to the Artist Graphics system, or you can purchase a $195 cable assembly, which also includes some interface circuitry for pass-through support. The daughtercard's VGA circuitry is built around Cirrus Logic chips and uses an Award VGA BIOS, but it is limited to 256K of soldered-in display memory and cannot support 256 colors at 640-by-480 resolution. The compatibility of the VGA daughtercard proved quite good in general, but it was off by about 20 percent in its interrupt timing. Oddly but forgivably, it displays its monochrome modes in amber rather than white-on-color screens.

An automatic setup procedure makes installation relatively easy if you have one of the high-end monitors supported by Artist Graphics. The instructions are clear but hard to handle, as both the basic board,

1,024-BY-768 COPROCESSED GRAPHICS ADAPTERS: SUMMARY OF FEATURES

Products listed in ascending price order

	Desktop AGA 1024	ATI 8514/Ultra	Spectragraphics Squeegee Graphics Adapter	National Volante AT1000	SOTA 340i	Applan Rendition II	ADEX 8514/AT256
List price	$695	$799	$845	$995	$995	$1,295	$1,299
PHYSICAL CHARACTERISTICS							
Board size (L x H, in inches)	13.5 x 4.5	9 x 3.5	13.3 x 4.2	13.2 x 4.5	14.4 x 5.9	13.4 x 4.8	9.8 x 4
HIGH-RESOLUTION CHARACTERISTICS							
High-resolution graphics coprocessor	TI TMS34010 (40 MHz)	ATI 8514/A	TI TMS34010 (50 MHz)	TI TMS34020 (32 MHz)	TI TMS34010 (50 MHz)	TI TMS34010 (50 MHz)	Western Digital 8514/A
8514/A register–compatible	❑	■	❑	❑	❑	❑	■
8514/A adapter interface–compatible	■	■	❑	❑	■	■	■
VGA SUPPORT							
On-board VGA	❑	❑	❑	■	❑	❑	❑
VGA BIOS manufacturer	N/A	N/A	N/A	Tseng	N/A	N/A	N/A
VGA memory	N/A	N/A	N/A	512K	N/A	N/A	N/A
DISPLAY CHARACTERISTICS							
Maximum addressable resolution (pixels)	1,024 x 1,024	1,024 x 1,024	1,024 x 1,024	1,024 x 768	1,280 x 1,024	1,024 x 2,048	1,024 x 1,024
Maximum displayable resolution (pixels)	1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768	1,024 x 768
Maximum number of colors simultaneously displayable	256	256	256	256	256	256	256
Palette (number of colors available)	16.7 million	16.7 million	256,000	16.7 million	16.7 million	16.7 million	16.7 million
VIDEO STANDARDS							
1,280 x 1,024	❑	❑	❑	❑	■	❑	❑
1,024 x 768 (noninterlaced)	■	■	■	■	■	■	■
1,024 x 768 (interlaced)	■	■	■	■	■	■	■
800 x 600 (Super VGA)	■	❑	■	■	■	■	❑
640 x 480 (VGA)	■	❑	❑	■	■	■	❑
SOFTWARE DRIVERS							
AutoCAD	■	■	■	■	■	■	■
GEM	■	❑	■	❑	■	■	■
Microsoft Windows 3.0	■	■	■	■	■	■	■
Presentation Manager	❑	❑	■	❑	❑	❑	■
Ventura Publisher	■	❑	■	❑	■	■	❑

—Editors' Choice ■—Yes ❑—No

N/A—Not applicable: The product does not have this feature.

its enhancements, and its software are documented in separate slender pamphlets. The output of the XJS-1024 is an array of four miniature SMB video connectors instead of the more typical 15-pin or BNC connectors. You specify the monitor you use when ordering the board, and Artist Graphics supplies the appropriate adapter cable free of charge. A 15-pin VGA connector is available on the retaining bracket of the board but is used only for VGA display in two-monitor setups.

By default, the XJS-1024 produces only composite sync, though it can be factory-configured to work with monitors requiring other sync methods. In fact, sync proved to be the downfall of the XJS-1024 when it was connected to our Sony 1304 test monitor. The monitor never quite locked to the board, yielding images as wavy as Old Glory in a full gale. According to Artist Graphics, the XJS-1024 demonstrates its best only with high-end big-screen displays; it requires a wide sync range for its higher-resolution modes, up to an optional 108-kHz horizontal scanning frequency for 1,600 by 1,200 pixels. Artist Graphics makes the time-

FACT FILE

Artist XJS-1024
Artist Graphics, 2675 Patton Rd., St. Paul, MN 55113; 800-627-8478, 612-631-7800.
List Price: With 1MB DRAM, 1MB VRAM, $3,295. VGA daughtercard, $595; VGA pass-through assembly, $195; 1MB VRAM upgrade, $795; 3-D acceleration module, $995.
In Short: The Artist XJS-1024 is a truly high-end video card, both in price (the most expensive one here) and capabilities. Though showing good performance, it is designed to complement high-end display systems.

CIRCLE 614 ON READER SERVICE CARD

Western Digital 8514/A Paradise Combo	Hercules Graphics Station Card GB1024+2	NEC MultiSync Graphics Engine	Nth Engine/150	HP Intelligent Graphics Controller 20	Vermont Cobra Plus	Artist XJS-1024	Rasterex Liberty 810AT
$1,398	$1,495	$1,499	$1,695	$2,499	$2,695	$3,295	$3,695
13.5 x 4.2	13.5 x 4.8	13.5 x 4.8	13.4 x 4.8	13.4 x 4.8	13.4 x 4.8	13 x 4.3	13.8 x 4.3
Western Digital 8514/A	TI TMS34010 (60 MHz)	TI TMS34010 (50 MHz)	Chips and Technologies 8514/A	TI TMS34020 (30 MHz)	TI TMS34010 (60 MHz)	TI TMS34020 (32 MHz)	TI TMS34010 (50 MHz)
■	❑	❑	■	❑	■	❑	❑
■	❑	❑	■	❑	■	❑	■
■	■	■	❑	❑	❑	❑	■
Western Digital 256K	Hercules 256K	NEC 256K	N/A N/A	N/A N/A	N/A N/A	N/A N/A	Rasterex 1MB
1,024 x 768	1,024 x 768	1,024 x 768	2,560 x 2,048	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,024 x 2,048
1,024 x 768	1,024 x 768	1,024 x 768	1,024 x 768	1,280 x 1,024	1,024 x 768	1,280 x 1,024	1,280 x 1,024
256	256	256	256	256	256	256	256
16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million	16.7 million
❑	❑	❑	❑	■	❑	■	■
■	■	■	■	■	■	■	■
■	■	■	■	❑	❑	■	■
❑	■	■	❑	❑	❑	■	■
■	■	■	❑	❑	❑	■	■
■	■	■	■	■	■	■	■
■	❑	■	❑	■	■	❑	■
■	■	■	■	■	■	■	■
❑	❑	❑	■	❑	❑	❑	❑
■	❑	■	❑	■	■	■	■

"A Solid, Complete Machine For The Rest Of The

Weight It is important for a notebook PC to weigh at least 6-7 lbs. Many of our customers (and even Computer Shopper) who have had experience with the 4-5 lb. "lightweights" all agreed that they are too flimsy. The 6-7 lb. machines offer a much sturdier box and will work out better in the long run.

Keyboard The layout of a keyboard and the size of the keys make all the difference in the world. Is there a large enter key? Is the "Ctrl" key in one of the two normal spots? Are the arrow keys arranged in an inverted "T" fashion? Is there an external keyboard connector?

Size How easily will the notebook, along with the AC adapter, fit into a brief case? Specifically, will the notebook fit side-ways into half of your briefcase? Sounds minor, but it's important.

Speed You can never have too much of this valuable commodity. A 12 or 16MHz machine may be adequate for some uses but Windows users and those who operate in graphics-intensive environments really appreciate the extra MIPS.

Memory **Expansion:** Does the computer use industry standard memory (SIMMs or SIPs), or does it use proprietary memory? If proprietary memory: (1) Will the company be around long enough to allow future upgrades? (2) How much does the proprietary memory cost? (3) What happens when a product is discontinued?

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NB/320SX
20MHz/LCD/VGA
2MB/20MB HD

Expansion **Chassis / Docking Station:** Availability of an expansion chassis will effectively guarantee your notebook's future in the event you eventually require a LAN adapter, scanner card, tape backup, or similar peripheral device.

Screen The good notebooks use the latest triple-twist LCD technology which provides great clarity and excellent readability. Low-end notebooks tend to use the older double-twist screens which will fade out when being viewed from an angle.

I/O Ports A complete notebook should have at least one parallel port, two serial ports, a VGA monitor port, K/B port for your favorite keyboard, and an internal modem slot.

Battery In general, a notebook's battery will carry a 2-hour charge or more. Is there a "suspend" button for use when the battery is replaced? How much does a spare battery cost? Recharger?

Return **Policy:** Regardless of the ad, make sure the money back guarantee is a no-questions-asked deal. And make them state specifically that there is no restocking fee. You want a couple weeks to see if you feel comfortable with the system. Be prepared, however, to pay the round-trip shipping charges if you choose to return the system.

Price The big thing here is value. Comparison shop the exact configuration you intend to own in six months. Do not assume that peripherals purchased later will be priced the same by all manufacturers. High-priced add-ons to a cheap system may reverse rankings made strictly on base prices.

That Sets The Standard Industry...."

March 1991, Computer Shopper

Notebook Buyers' Checklist:

Standard Features	DATAWORLD NB-320SX	BRAND X
Weight	7 lbs	
Processor type	80386SX	
Processor speed	20 MHz	
Base Memory	2 MB	
Floppy drive	1.44 MB	
Display technology	Triple twist VGA	
Display Resolution	640x480, 32 gray scales	
Battery Type	Nicad D-cell	
Parallel port/Serial ports	1/2	
Dedicated modem slot?	✓	
External VGA support?	✓	
External keyboard support?	✓	
Expansion box available?	✓	
DOS included?	✓ (4.01)	
Carrying case included?	✓	
Other software included?	✓ (FastLynx)	
Optional Features:		
Memory upgrade path	4MB, 8MB, 16MB	
Hard drives available	40MB, 60MB	
Numeric coprocessor	387-20SX	
Replacement battery	✓	

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base crystal on the XJS-1024 interchangeable to allow 60- or 75-Hz frame rates in all but this highest-resolution mode, which is limited to 60 Hz.

As for drivers, Artist Graphics supplies its own enhanced protected-mode *AutoCAD* display-list driver, but it relies on TIGA for compatibility with other applications. However, it does include a *Microsoft Windows* 3.0. driver. As you would hope when you've spent this much for a board, the XJS-1024's performance is excellent, with the fastest times on the *Windows* aligned and nonaligned BitBlt tests, and superb *AutoCAD* times as well.

The price of the Artist Graphics XJS-1024 will rule it out for many people, but the board is not high-end simply because of its price. The XJS-1024 is really a board for those who want the power to match elaborate display systems. Think of its 1,024 by 768 abilities as a stepping stone to a *truly* large high-resolution display.

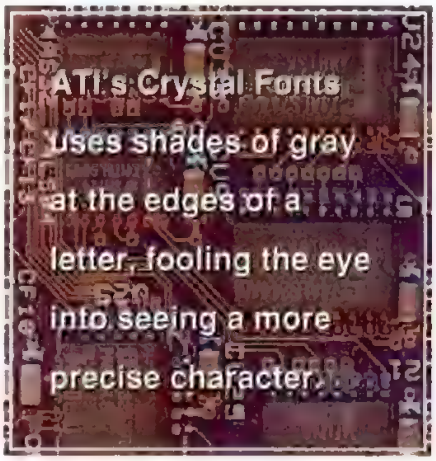
ATI TECHNOLOGIES INC.

ATI 8514/Ultra

by Matthew J. Ross

The ATI 8514/Ultra is the high-performance king of ATI Technologies' product line, and our tests prove that it deserves the crown. The performance of this 8514/A-compatible board proved as good or better than TMS34020-based boards that cost significantly more. At $599 for the 512K version and $799 for the 1MB version we evaluated, the 8514/Ultra is a great deal, even without Crystal Fonts, its anti-aliased screen-font technology for *Windows* 3.0, which makes small type much more readable on-screen.

PC Magazine's first introduction to the 8514/Ultra could hardly be called a pleasant experience (see "ATI 8514/ULTRA: Anti-Aliased Fonts for Windows," First Looks, *PC Magazine*, April 16, 1991). Though the board, which supports both 16-bit ISA and Micro Channel architecture via a flip-flop design, showed excellent hardware engineering, it was crippled in practice by poor installation software. By the time it was tested for this roundup, though, ATI Technologies had successfully addressed these problems. Installation is now a clean, relatively simple process. A menu-based utility lets you select the appropriate monitor type (the board has a 70-Hz reduced-flicker option), copy *AutoCAD* and *Windows* drivers to your hard disk, store Crystal Fonts, or run test utilities.



For *AutoCAD*, ATI's installation program creates the appropriate ADI (*AutoCAD* Device Interface) driver for the version you are using; you then simply reconfigure *AutoCAD* by selecting it from the list of drivers. *Windows* 3.0 installation is equally straightforward; just run Microsoft's setup program from the DOS prompt, then select one of ATI's own *Windows* drivers—a so-called "fast" *Windows* driver, which uses *Windows*' own 8514/A screen fonts, or ATI's own Crystal Fonts driver, which uses its own built-in anti-aliased screen fonts.

Crystal Fonts works by substituting shades of gray at the edges of a letter, fooling the eye into seeing a more fully formed precise character. The results are certainly commendable—10- and 12-point fonts are crisp and clearly legible, and type as small as 5 points was readable on the 14-inch Sony MultiScan HG monitor we used for testing. The board's 13 Bitstream fonts (in Dutch, Swiss, Courier, and Symbol typefaces) correspond to the 13 basic PostScript fonts. ATI says it is working on a utility to convert Bitstream and Adobe Type 1 outlines to Crystal Fonts format.

In either case, the ATI 8514/Ultra's performance was first rate. It was easily in the midrange for speed under *AutoCAD*, and it was consistently first or second in performance under *Windows* 3.0. Our published PC Magazine Labs benchmark test results were produced using ATI's fast driver, but though the overhead of anti-aliasing should make ATI's Crystal Fonts slower, on some tests it actually proved faster than the fast driver.

The 8514/Ultra has no on-board VGA option, so you will have to rely on pass-through from an external VGA adapter or a dual-monitor setup for VGA support. For those who require integrated VGA, ATI Technologies is planning to release a version (the 8514/Ultra+VGA) that incorporates the functionality of the company's Editors' Choice–winning VGA Wonder board, for a very good price. It should be available this summer in 512K and 1MB models with list prices of $699 and $899, respectively.

The 8514/Ultra's excellent performance and affordable low cost are by themselves reason to invest in it; coupled with its dual-bus support and Crystal Fonts technology, the 8514/Ultra is in a class by itself.

FACT FILE
EDITORS' CHOICE

ATI 8514/Ultra
ATI Technologies Inc., 3761 Victoria Park Ave., Scarborough, Ontario, Canada M1W 3S2; 416-756-0718.
List Price: With 512K VRAM, $599; with 1MB VRAM, $799. VGA adapters, $99 to $399; additional Crystal Fonts, $199.
In Short: The ATI 8514/Ultra delivered excellent performance and came bundled with its own anti-aliasing Crystal Fonts software. At this price, it is the card to beat.

CIRCLE 615 ON READER SERVICE CARD

DESKTOP COMPUTING

Desktop AGA 1024

by Winn L. Rosch

The promise of the AGA-1024 from Desktop Computing is intriguing—a powerful graphics coprocessor with a fit-any-PC design at a modest $695 price. Indeed, this board has the potential to be a top choice and a good buy for high-resolution graphics, but its poor documentation and abysmal performance under *Microsoft Windows* 3.0 may make you say "good-bye" instead.

Based on a 40-MHz TI TMS34010 coprocessor, the AGA 1024 is a full-length 16-bit board, though it can be made to work an 8-bit slot by adjusting an on-board jumper. It comes with 1MB of VRAM and 256K of DRAM, but its memory is not expandable. There is no on-board VGA option; the board comes only with a tiny 3-inch cable for passing

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CIRCLE 304 ON READER SERVICE CARD

through VGA signals from an external adapter. The board works both with 8514-style interlaced displays and multiscanning monitors for noninterlaced images, but it supports only a 60-Hz frame rate. It does offer 800-by-600 and 640-by-480 resolutions as well as the standard 1,024-by-768 resolution.

BURDEN OF INSTALLATION

Installation proved to be a problem. Though reasonably complete, its documentation was in disarray—a collection of separate hardware and software manuals, each complete with an addendum *and* an addendum to the addendum. Also, the automatic software installation procedure did not match the documentation.

The Desktop AGA 1024 comes with standard TIGA drivers plus an 8514/A application interface–level driver. It performed reasonably well with *AutoCAD*, but its *Windows* 3.0 performance proved lethargic: It was the slowest of the tested boards on all the *Windows* tests. In fact, in 1,024-by-768 mode, it proved slower than the average Super VGA board, despite its powerful on-board graphics coprocessor. The AGA 1024 also experienced compatibility problems in the Compaq Deskpro 386/25e we used for evaluation; eventually a helpful factory technician was able to talk us through the correct setting of the two on-board jumpers to move some of the addresses used by the board. However, part of the address range used by the board cannot be reassigned, which may pose problems for some installations.

Obviously the AGA 1024 is not a board to buy if you prefer speedy displays and well-organized documentation. While its low price may make it interesting at first glance, other products offer more-effective high-resolution solutions.

FACT FILE

Desktop AGA 1024
Desktop Computing, 4600 Bohannon Dr., #220, Menlo Park, CA 94024; 415-323-5535.
List Price: With 256K DRAM, 1MB VRAM, $695.
In Short: Desktop's AGA-1024 seems like a great buy if you only glance at the price tag (the least expensive here). But its poor performance and disorganized documentation should make you look elsewhere.

CIRCLE 618 ON READER SERVICE CARD

COVER STORY
GRAPHICS ADAPTERS

HERCULES COMPUTER TECHNOLOGY INC.

Hercules Graphics Station Card GB1024+2

by Alfred Poor

Ever since Hercules started drawing pictures on IBM's monochrome displays, the company has been actively pushing to extend the graphics capabilities of PCs. The arrival of the Hercules Graphics Station Card GB1024+2 heralds a further advance for the cause. With a 60-MHz TI TMS34010 graphics coprocessor plus on-board VGA circuitry, the Graphics Station Card is one of the few cards in this review capable of supporting true 24-bit color on-screen as well as the standard 256 colors simultaneously displayable. Its relatively low $1,024 base-price marks the Graphics Station Card as one of the standout products in this group.

The base model, the GB1024, comes with 1MB of VRAM installed, sufficient for 1,024-by-768 resolution with 256 colors. In lower resolution modes (such as its 256-color 640-by-480 resolution), the extra VRAM is used as off-screen memory to store temporary images. The card we tested was the GB1024+2 model; with a list price of $1,495, it comes with an additional 2MB of DRAM that is used to store program code and data for the TI TMS34010 coprocessor. Both cards offer a 24-bit true-color mode that gives you a show-stopping 16.7 million colors to choose from at 512-by-480 pixels (a resolution supported by some Targa boards). The tested board doesn't support the reduced-flicker options that others do, however: Vertical refresh rates are only 56 Hz for 800-by-600 resolution or 60 Hz for 1,024-by-768 resolution modes.

FACT FILE

Hercules Graphics Station Card GB1024+2
Hercules Computer Technology Inc., 921 Parker St., Berkeley, CA 94710; 415-540-6000.
List Price: GB1024, with 1MB DRAM, $1,024; GB1024+2, with 2MB DRAM, $1,495.
In Short: The Hercules Graphics Station Card GB1024+2 was a respectable performer, and it did not stand out from the other cards in price, either. Coupled with excellent documentation and reliable software support, this adapter is a strong contender.

CIRCLE 617 ON READER SERVICE CARD

Installation is fairly easy, despite the fact that three separate revised sets of documentation and driver disks arrived while we were testing. The manual is clearly written with good illustrations. You can install the Graphics Station Card in any 16-bit ISA slot; it will work in an 8-bit slot, but Hercules does not recommend this since it degrades performance significantly. The board is backed by a generous two-year parts-and-labor warranty. The free telephone technical support is very good, but the service is not available until 8:30 A.M. Pacific time. East-coast users will have to wait until late morning.

In addition to *Microsoft Windows* 3.0 and *AutoCAD* support, the board comes with drivers for *AutoShade*, *AutoSketch*, and *3D Studio*, as well as support for TIGA 1.1 and 2.0. Revised drivers for these boards seem to arrive with the regularity of a neighborhood ice cream truck in July. The board turned in only average performance figures on PC Magazine Labs' benchmark tests. Though its speed on the *AutoCAD* Full-Screen Redraw was a little faster than most, and the card did better than average on the *Windows* Rectangular Clipping test, on all other tests the performance was middle-of-the-pack or worse. There were also a few minor anomalies in the VGA compatibility tests, though none of these are likely to cause problems with most applications.

Still, in terms of software support, ease of installation, and quality of documentation, this card is a strong contender. There may be boards that offer similar features for a lower price, but if you need everything that the Hercules board can do—especially when it comes to 24-bit-color support—the Hercules Graphics Station Card is your best bet.

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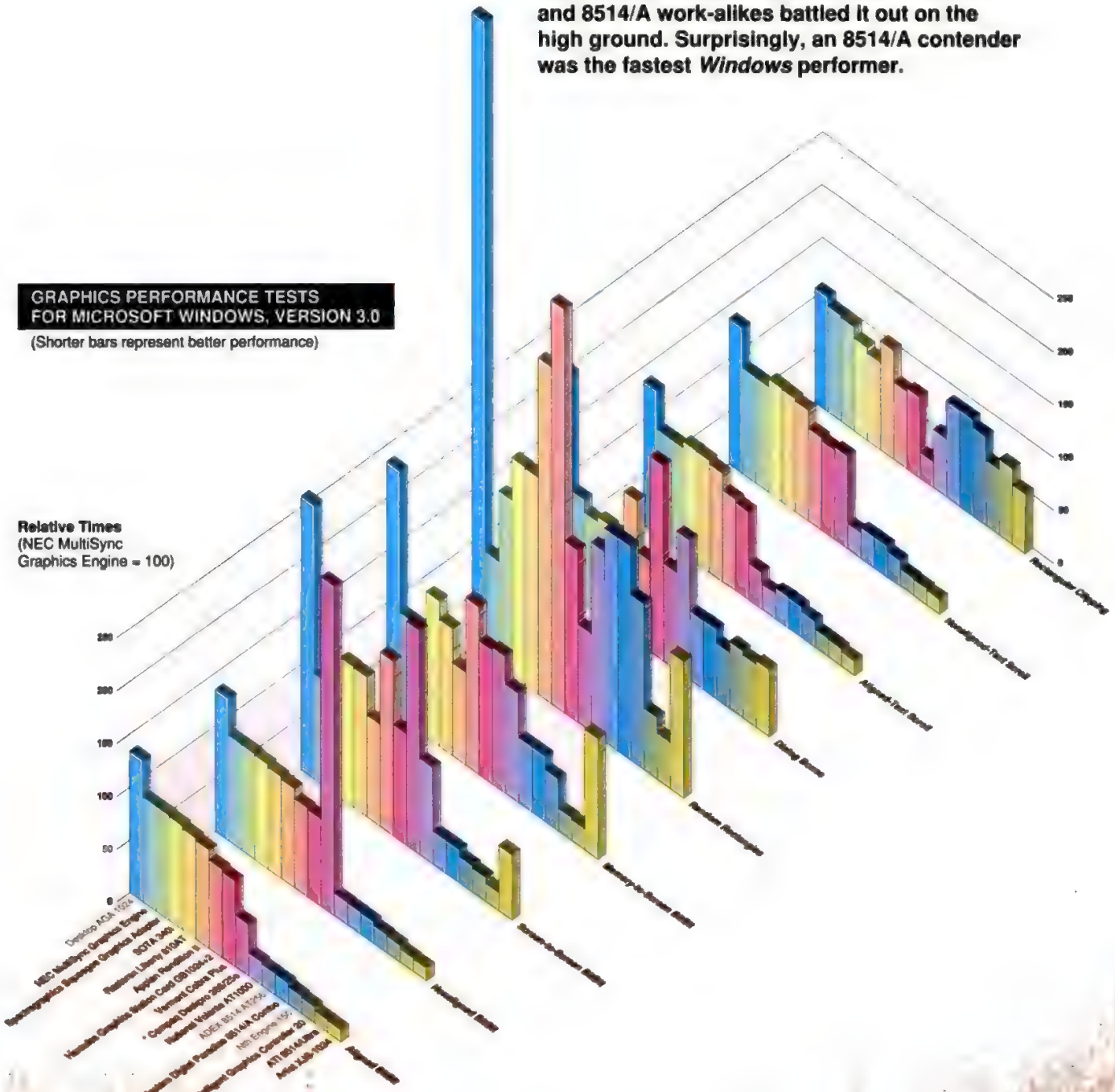
PERFORMANCE TESTS: 1,024-BY-768 COPROCESSED GRAPHICS ADAPTERS

On our *Microsoft Windows* 3.0 tests, the Texas Instruments TMS34010–based adapters were the slowest performers, while the TMS34020 and 8514/A work-alikes battled it out on the high ground. Surprisingly, an 8514/A contender was the fastest *Windows* performer.



* Reported for comparison.

TESTING ANALYSIS

The 15 boards reviewed here represent two different graphics coprocessor technologies: programmable and hardwired. They also span five different graphics coprocessor chips (the ATI 8514, the Texas Instruments TMS34010 and Texas Instruments TMS34020, the Chips and Technologies 82C480, and the Western Digital 8514) and four different *Microsoft Windows* 3.0 drivers (DGIS, 8514/A for *Windows*, TIGA, and one custom *Windows* driver).

The factors that most strongly affect the adapters' video performance under *Windows* are the graphics coprocessor and its associated driver. The boards based on either a TMS34020 or one of the 8514/A clones were faster than boards based on the TMS34010. This comes as no surprise: The TMS34020 has twice the on-chip cache memory (512 bytes versus the TMS34010's 256 bytes) and a shorter instruction cycle time (100 to 125 nanoseconds versus the TMS34010's 160 ns.). And the 8514 derivatives have certain graphics primitives hardwired onto the chip (which also give it an advantage over the TMS34010 in operations involving line drawing and BitBlts).

The fastest board on the aligned and nonaligned BitBlts (which indicate coprocessor performance) was the Artist XJS-1024. This board utilizes a TMS34020 chip (as do the HP and National Design boards) and a TIGA driver. It also had the fastest aligned- and nonaligned-text scrolls. By contrast, on the Screen-to-Screen BitBlt and Memory-to-Screen BitBlt tests—representing two of the most common ways *Windows* performs BitBlt operations—the Artist's speeds were not as outstanding but were better than average. Because these tests involve the *Windows* driver responsible for BitBlt raster operations, the logical conclusion is that the driver is hampering the board's performance, especially in the light of its excellent aligned and nonaligned BitBlt speeds.

The two boards showing the best combination of coprocessor and driver performance were the ATI 8514/Ultra and the HP Intelligent Graphics Controller 20. Of these two boards, the edge goes to the ATI 8514/Ultra, which squeaked by the HP on all but the Rectangular Clipping test. The ATI 8514/Ultra was also the fastest of all the 8514 work-alikes (this group also includes the ADEX 8514/AT256, the Nth Engine/150, and the Western Digital Paradise 8514/A Combo). This is due in part to the board's design but more to its custom *Windows* driver, which gave it superior performance on the Screen-to-Screen BitBlt and Memory-to-Screen BitBlt tests.

The ADEX and Western Digital boards exhibited almost identical performance. Since both boards use the Western Digital chip set and IBM's 8514 *Windows* driver, their performance differences are almost meaningless. The other 8514 work-alike, the Nth Engine/150, proved slightly faster than the two Western Digital chip set–based boards. Since all three used the same *Windows* driver, it would seem that the Nth Engine/150's advantage lies with the Chips and Technologies 8514 controller (the 82C480).

The fastest of the TMS34010-based adapters came from Vermont Microsystems. The Vermont Cobra Plus led the way with its 60-MHz TMS34010 coprocessor. On the other end of the TMS34010 spectrum was the Desktop AGA 1024 board; it was the slowest on all the tests except one (in which it placed second) and is also the only card with a 40-MHz TMS34010. When looking at TMS34010-based boards, be sure to check the graphics coprocessor's operation speed, which is a primarily important factor in terms of board performance.

The performance of the Spectragraphics Squeegee Graphics Adapter and the NEC MultiSync Graphics Engine on the Screen-to-Screen BitBlt and Memory-to-Screen BitBlt tests was among the best for the TMS34010-based boards. These two boards used the DGIS driver from GSS instead of the TIGA driver employed by the other TMS340x0 boards. If you use *Windows*, consider the driver before buying.

HOW WE TESTED

We tested each board in a Compaq Deskpro 386/25e equipped with 8MB of RAM, a 310MB hard disk, and a 25-MHz Intel 80387 math coprocessor. If a board had its own VGA circuitry, the Compaq's built-in VGA was disabled. For comparison, we are also reporting results for the Compaq's built-in VGA (which runs at 640-by-480 resolution and does not utilize a graphics coprocessor). All systems were equipped with Compaq DOS, Version 4.01.

To test the capabilities of the reviewed boards, PC Magazine Labs tested them in a variety of different environments. To reveal the performance differences of the boards when running *Microsoft Windows* 3.0, we used Release 1.1 of PC Magazine Labs' Graphics Performance Tests for *Microsoft Windows*. Each product performed ten iterations of each test, and we report its average time (except when noted).

To examine VGA performance, we used the new PC Labs VGA benchmark tests, developed in conjunction with Spirit of Performance. Because these tests don't use drivers or other software overhead to exercise the VGA circuitry, they accurately represent the VGA circuitry's performance. For those boards that had only VGA pass-through capability, we did not run VGA performance tests.

To look at these boards' performances in a CAD environment, we used *AutoCAD*, Release 10, running in protected mode. Whenever possible, we used a protected-mode driver; where the vendors did not have a protected-mode driver, we used a real-mode driver. For those drivers requiring expanded memory, we configured the Compaq CEMM utility to provide 2MB of expanded memory.

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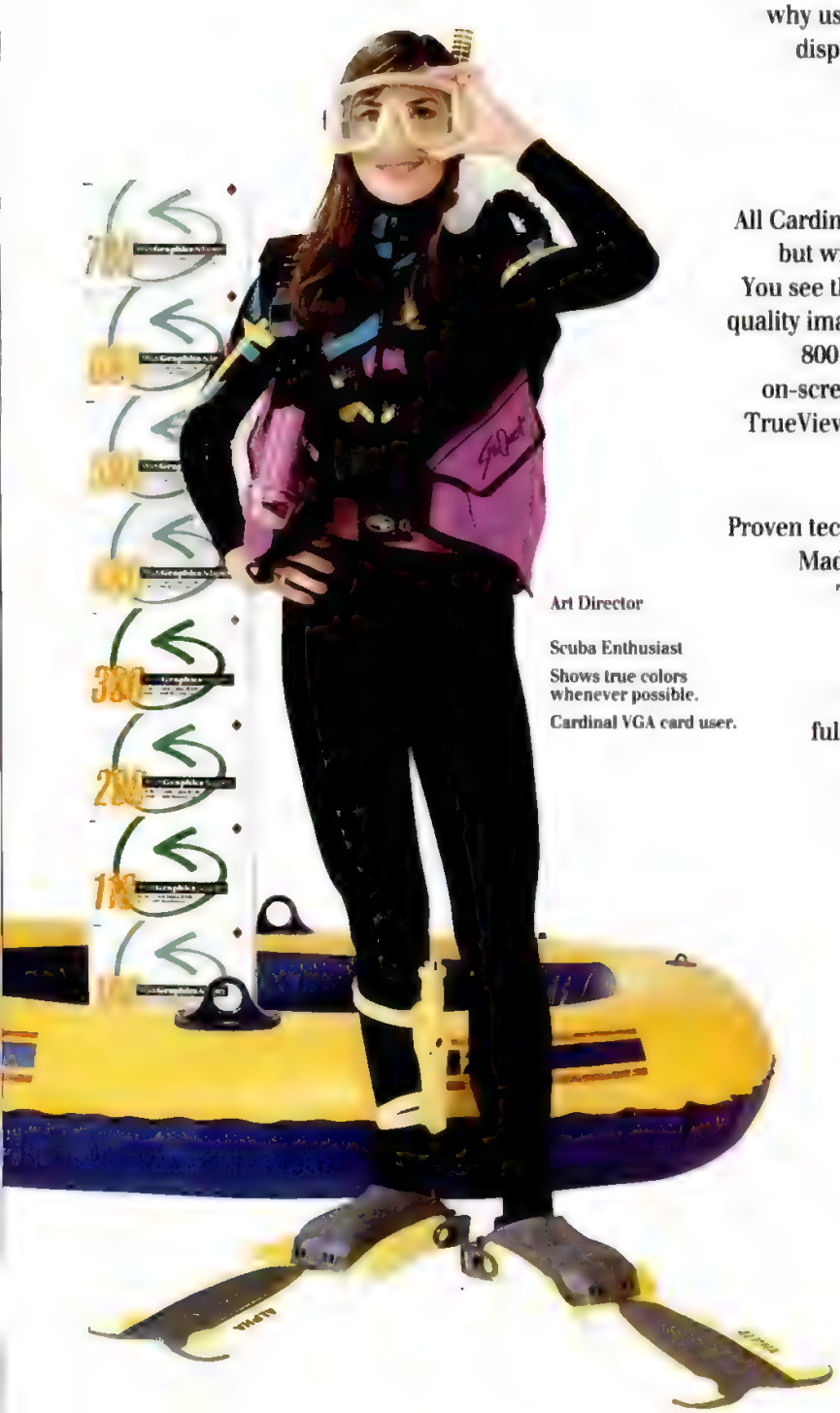

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8514/A driver	yes	yes
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PERFORMANCE TESTS: 1,024-BY-768 COPROCESSED GRAPHICS ADAPTERS

■ The **Aligned BitBlt** test draws a 256- by 256-pixel square and uses the *Microsoft Windows* 3.0 function BitBlt (bit-block transfer) to move it from one on-screen location to another. Using aligned BitBlts requires little CPU overhead because it is not necessary to compute the screen-memory offset position. Because the test does not perform other *Windows* raster operations, it is a good indicator of the graphics coprocessor's performance. We run the test ten times and report the average timing.

The **Nonaligned BitBlt** test draws a 256- by 256-pixel square and uses the *Windows* BitBlt function to move it from one on-screen location to another. Using nonaligned BitBlts requires a tremendous amount of CPU overhead because it is necessary to compute the screen-memory offset position. Graphics coprocessors can compute this overhead and therefore greatly increase nonaligned BitBlt performance. We run the test ten times and report the average timing.

The **Screen-to-Screen BitBlt** test uses the *Windows* BitBlt function to move data from one area of screen memory to another. It performs a number of *Windows* raster operation functions to manipulate bitmaps while performing BitBlt operations. This test measures the efficiency of the *Windows* driver as it minimizes the effects of the system bus. We run the test ten times and report the average timing for a BitBlt raster operation.

The **Memory-to-Screen BitBlt** test uses the *Windows* BitBlt function to move data from system memory to screen memory. It performs a number of *Windows* raster operation functions to manipulate bitmaps while performing BitBlt operations. This test measures the efficiency of the *Windows* driver as it transfers bitmap data across the system bus. We run the test ten times and report the average timing for a BitBlt raster operation.

The **Random Rectangles** test measures the time it takes the graphics adapter and driver to draw a series of random rectangles, which is a common *Windows* operation. We run the test ten times and report the average time required to draw a rectangle.

■ The **Dialog Boxes** test generates and erases a *Windows* dialog box by using the *Windows* CreateDialog and EndDialog functions. Creating dialog boxes is a common *Windows* function. We run the test ten times and report the average time required to generate and erase a dialog box.

■ The **Aligned-Text Scroll** test scrolls aligned text down an on-screen window. We run the test ten times and report the average time required to scroll one screen of text.

■ The **Nonaligned-Text Scroll** test scrolls nonaligned text down an on-screen window. We run the test ten times and report the average time required to scroll one screen of text.

■ The **Rectangular Clipping** test performs clipping functions on text, lines, and bitmaps. Clipping is used when part of an image must be moved while another part is still being displayed (for example, when you drag an image across a window). We run the test ten times for each of the three types of clipping procedures, calculate the three average timings, and report the total of the three.

GRAPHICS PERFORMANCE TESTS FOR MICROSOFT WINDOWS, VERSION 3.0

(Lower scores represent better performance)

	Aligned BitBlt Average Time (milliseconds)	Nonaligned BitBlt Average Time (milliseconds)	Screen-to-Screen BitBlt Average Time (milliseconds)	Memory-to-Screen BitBlt Average Time (milliseconds)	Random Rectangles Average Time (milliseconds)	Dialog Boxes Average Time (milliseconds)	Aligned-Text Scroll Average Time (milliseconds)	Nonaligned-Text Scroll Average Time (milliseconds)	Rectangular Clipping Average Time (milliseconds)
Desktop AGA 1024	34.48	35.02	108.51	121.01	28.82	819.01	45.83	47.04	4.15
NEC MultiSync Graphics Engine	25.69	26.03	41.77	51.62	4.80	391.15	33.62	34.22	3.84
Spectragraphics Squeegee Graphics Adapter	25.67	26.04	41.75	51.54	8.00	346.05	33.68	34.16	3.78
SOTA 340I	25.39	25.74	55.72	71.00	9.94	364.29	35.77	36.72	3.38
Rasterex Liberty 810AT	24.79	25.10	55.43	62.15	9.90	355.45	35.63	36.52	3.18
Applan Rendition II	24.19	24.51	40.40	45.48	15.34	526.63	34.62	35.75	3.96
Hercules Graphics Station Card GB1024+2	21.79	22.02	68.98	81.95	18.36	338.51	29.24	29.96	2.81
Vermont Cobra Plus	21.18	21.59	44.05	65.41	7.85	726.99	28.33	28.98	2.95
* Compaq Deskpro 386/25e	12.75	81.43	88.63	66.93	4.48	366.80	12.00	30.05	0.95
National Volante AT1000	5.78	5.69	38.20	53.43	8.65	519.32	8.16	8.36	2.12
ADEX 8514/AT256	5.29	5.53	13.15	32.04	9.73	256.46	10.00	10.13	3.51
Western Digital Paradise 8514/A Combo	5.16	5.40	13.16	32.00	9.75	258.85	9.87	10.06	3.52
Nth Engine/150	4.42	4.48	10.57	25.52	7.53	208.40	8.32	8.41	3.23
HP Intelligent Graphics Controller 20	4.02	4.21	9.72	11.16	2.81	249.21	5.78	5.90	2.39
ATI 8514/Ultra	3.06	3.39	7.34	10.33	2.10	234.71	5.64	5.54	2.77
Artist XJ9-1024	2.94	3.20	26.12	59.08	6.22	248.86	4.67	4.80	2.17

* Reported for comparison.

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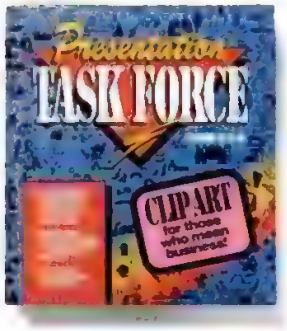

★ Presentation Task Force

(New Vision Technologies) Clip art for those who mean business. Presentation Task Force contains 1,100 vector graphics in the popular CGM format, making it compatible with most PC charting, drawing and word processing programs. The collection has been designed for business, health care and military professionals, and is suitable for all types of color and black and white printers. **GR0823/5 $134.**

★ After Dark

(Berkeley Systems) After Dark prevents screen burn-in with over 35 fantastic displays and two level password protection. Use flying toasters or a logo as screen saving art, type in messages or set up slide show style presentation. The SystemIQ task manager maximizes performance while running After Dark. Features DOS blanking, even without Windows 3.0 **GR1994 $29.**

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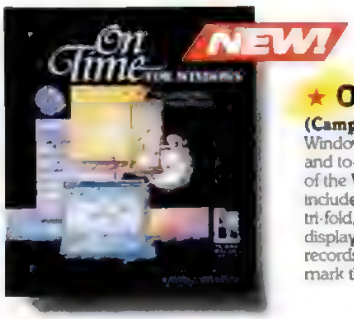

★ OnTime for Windows

(Campbell Services, Inc.) OnTime for Windows is an easy to use, lifetime calendar and to-do list manager that takes full advantage of the Windows 3.0 environment. Features include: attractive calendar printouts including a tri-fold, week and month-at-a-glance graphic displays, automatic protection of recurrent records, to-do items that roll over until you mark them done and more. **BS3584 $75.**

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★ PictureEze

(Application Techniques, Inc.) PictureEze, a graphics file converter for Windows 3.0, supports a variety of different input file formats. Converts images into the correct file format your application requires. Features flexible output file types, superior image modification, flexible color enhancements, quick results and repeat operations to convert a series of images. **GR2134 $99.**

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DR0010	20Mb Cartridge	59.
DR0560	Bernoulli Box II 44Mb Int.	825.
DR1180	Bernoulli Transportable	990.
MicroSolutions		
DR1790	backpack 2.8Mb	299.
Optical Access International		
CD0180	CM 50 Portable CD-ROM	399.
Plus Development		
DR1000	Hardcard II 80 (19ms)	589.
DR1250	105Mb Hardcard 2XL	699.

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PR1600	Adobe PostScript Cartridge	305.
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PR1314	★ Adobe Plus Pack for PC	115.
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PR1750	NP80-24E Printer	329.
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MM0690 HC2400S w/9600 Sendfax Int. ... 99.
MM0660 MX2400S w/9600 Sendfax Ext. ... 109.
MM0600 Modem V.42bis 2400 Ext. ... 169.
MM0820 V.32bis Turbo ... 455.

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IN0984/94 ★The Typist (AT/PS/2) ... 419.

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MT0240 14" Multiscan CPD-1304 ... 705.

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EN0734 Simcity ... 29.
EN0864 The Playroom ... 27.
ED0784 Where is Carmen S.D. Deluxe Ed ... 49.
Where is Carmen S.D.(various) . ea.32.

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Entertainment On Line
EN2013/5 Lottery Tracker & Wheeler ... 25.

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ED0913/5 Pronunciation Tutor (Fr/Span) ... 59.
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ED0514/04 Word/Number Munchers ... ea.29.
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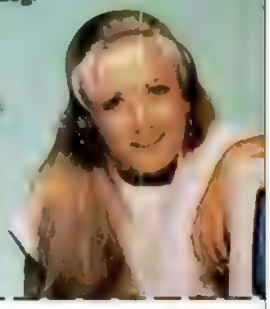

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GR1854	★ Intermission	35
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BS0214	Paradox 3.5	519.
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BS2894 ★ PackRat 3.0 ... 259.
Precision Software
BS1874 ★ Superbase 4 Windows ... 425.
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UT1044 ★ Your Way ... 119.
QMS
BS1624 ★ Ultrascript PC Plus 2.1 ... 279.
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UT0683/5 386Max Professional 5.1 ... 75.
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EX1103/5 ★ QEMM 386 5.1 ... 61.
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BS0653 Q&A 3.0 ... 235.
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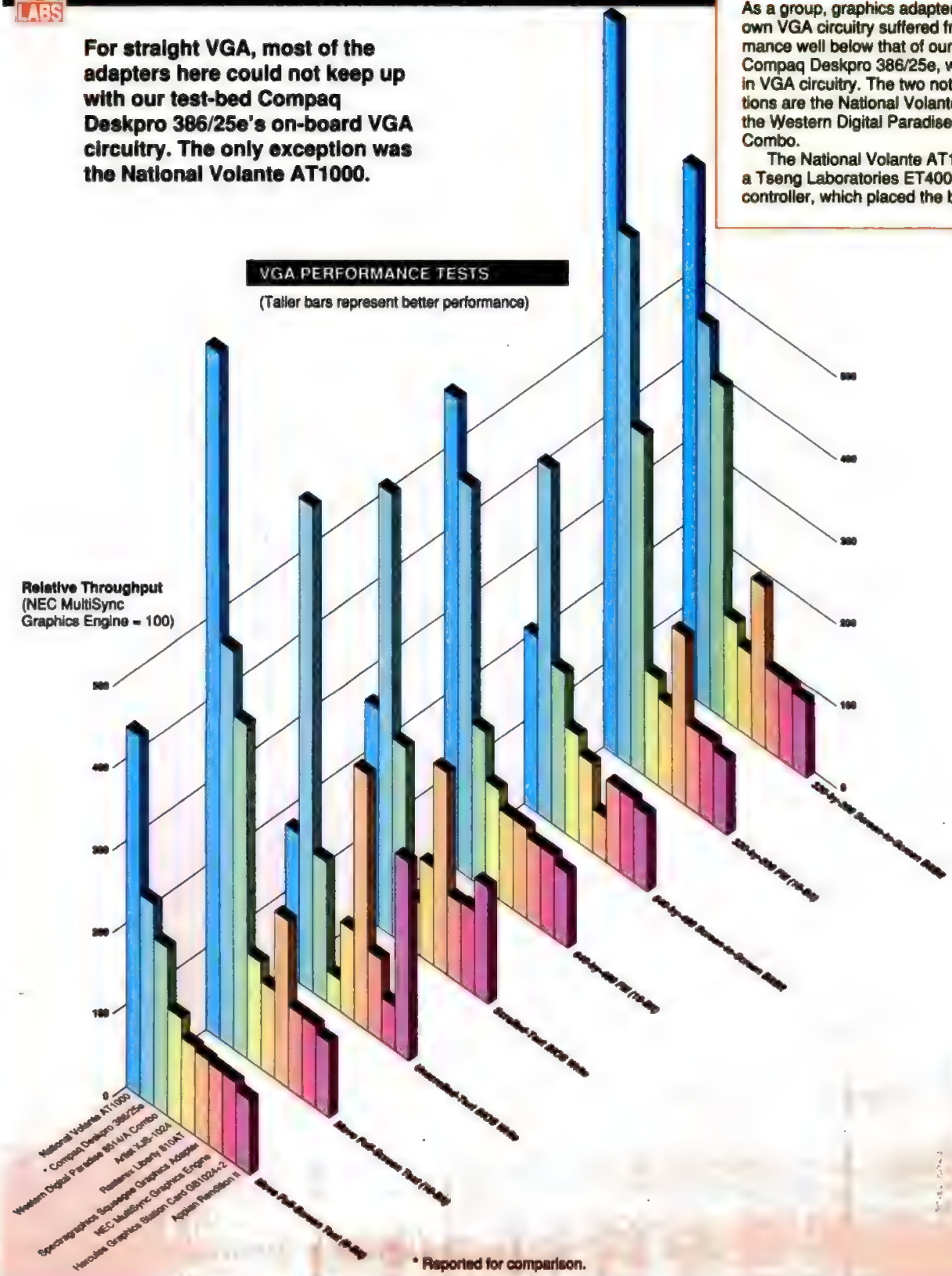
PERFORMANCE TESTS: 1,024-BY-768 COPROCESSED GRAPHICS ADAPTERS

For straight VGA, most of the adapters here could not keep up with our test-bed Compaq Deskpro 386/25e's on-board VGA circuitry. The only exception was the National Volante AT1000.

TESTING ANALYSIS

As a group, graphics adapters with their own VGA circuitry suffered from performance well below that of our test-bed Compaq Deskpro 386/25e, which has built-in VGA circuitry. The two notable exceptions are the National Volante AT1000 and the Western Digital Paradise 8514/A Combo.

The National Volante AT1000 employs a Tseng Laboratories ET4000 VGA controller, which placed the board in the



* Reported for comparison.

lead in terms of graphics performance. In fact, its performance on the 320-by-200 Fill and 320-by-200 Screen-to-Screen BitBlt tests (which are good indicators of performance at resolutions beyond VGA) was so good that using this controller for Super VGA resolution should prove very acceptable.

The Paradise 8514/A Combo was also a standout VGA performer—though it did not beat the Compaq's built-in circuitry. Its Western Digital VGA chip set was the prime contributor to the board's excellent results.

Interestingly, only the National Volante AT1000, Western Digital Paradise 8514/A Combo, and Spectragraphics Squeegee Graphics Adapter boards had 16-bit I/O VGA circuitry, which made its presence obvious by doubling their performance from the 8-bit Move Full-Screen test to the 16-bit Move Full-Screen test. The rest of the boards tested had the same performance on both of these tests, indicating that they operate through an 8-bit I/O path.

Finally, none of the boards displayed BIOS write performance anywhere near that of the test-bed Compaq Deskpro 386/25e. This is due mainly to the shadowing of the video BIOS. Compaq shadows the video BIOS for its built-in video, but it does not shadow with an add-in video board installed.*

■ The **Move Full-Screen Text (8-Bit)** test writes text to the graphics adapter's screen memory via 8-bit moves. A full-screen move best represents adapter throughput because there is almost no software overhead involved. We run the test for ten seconds and report the results in kilocharacters per second (1 kilocharacter = 1,000 characters).

■ The **Move Full-Screen Text (16-Bit)** test writes text to the graphics adapter's screen memory via 16-bit moves. A full-screen move best represents adapter throughput because there is almost no software overhead involved. On this test, those boards taking advantage of the 16-bit interface will display roughly twice the throughput achieved on the 8-bit move test. We run the test for 10 seconds and report the results in kilocharacters per second.

■ The **Unscrolled-Text BIOS Write** test writes text to the screen via interrupt 10h BIOS calls. After filling the screen with text, the cursor moves back to the top of the screen and repeats the procedure. This test measures the video BIOS's efficiency. We run the test for 10 seconds and report the results in kilocharacters per second.

The **Scrolled-Text BIOS Write** test writes text to the screen via interrupt 10h BIOS calls. After filling the screen with text, each successive text line is teletyped to the screen's bottom, and a line of text at the top is erased. This test measures forced-scrolling text performance loss and examines the efficiency of the video BIOS. We run the test for 10 seconds and report the results in kilocharacters per second.

The **640-by-480 Fill (16-Bit)** test fills the video memory with color information via VGA write mode 0 (a common write mode used by many software programs). This test measures the graphics adapter's throughput in graphics mode. We run the test for 10 seconds and report the results in megapixels per second (1 megapixel = 1,000,000 pixels).

■ The **640-by-480 Screen-to-Screen BitBlt** test divides video display memory into four sections. The first three sections contain different-colored fill patterns. This test measures the graphics adapter's performance when it moves pixels from these three sections to the fourth; it minimizes the effects of the system bus. We run the test for 10 seconds and report the results in megapixels per second.

■ The **320-by-200 Fill (16-bit)** test fills the video memory with color information utilizing the 256-color VGA mode at 320-by-200 resolution. This test predicts 256-color Super VGA performance (if the adapter supports it). We run the test for 10 seconds and report the results in megapixels per second.

■ The **320-by-200 Screen-to-Screen BitBlt** test divides video display memory into four sections. The first three sections contain different-colored fill patterns. This test measures the graphics adapter's performance when moving pixels from these three sections to the fourth; it also predicts the graphics adapter's performance in 256-color Super VGA mode (if the adapter supports it) while minimizing the effects of the system bus. We run the test for 10 seconds and report the results in megapixels per second.

VGA PERFORMANCE TESTS

(Higher scores represent better performance)

	Move Full-Screen Text (8-Bit) (kilocharacters per second)	Move Full-Screen Text (16-Bit) (kilocharacters per second)	Unscrolled-Text BIOS Write (kilocharacters per second)	Scrolled-Text BIOS Write (kilocharacters per second)	640-by-480 Fill (16-Bit) (megapixels per second)	640-by-480 Screen-to-Screen BitBlt (megapixels per second)	320-by-200 Fill (16-Bit) (megapixels per second)	320-by-200 Screen-to-Screen BitBlt (megapixels per second)
National Volante AT1000	1,218.81	2,318.51	8.82	6.73	26.71	4.88	5.32	1.89
* Compaq Deskpro 386/25e	686.31	1,346.17	28.70	13.72	22.28	9.84	3.83	1.36
Western Digital Paradise 8514/A Combo	570.02	1,129.53	8.30	6.15	8.91	4.44	2.47	1.18
Artist XJS-1024	362.00	359.94	1.88	1.65	6.21	2.97	0.78	0.38
Rasterex Liberty 810AT	296.73	296.92	5.38	3.03	5.13	2.46	0.64	0.30
Spectragraphics Squeegee Graphics Adapter	285.48	568.51	15.19	6.28	5.13	1.22	1.23	0.58
NEC MultiSync Graphics Engine	277.97	277.60	4.85	2.55	4.67	2.29	0.60	0.29
Hercules Graphics Station Card GB1024+2	276.29	275.91	2.61	2.61	4.67	2.29	0.60	0.29
Appian Rendition II	252.48	252.65	11.75	3.65	4.27	2.13	0.55	0.27

* Reported for comparison.

* The ADEX 8514/AT256, ATI 8514/Ultra, Desktop AGA 1024, HP Intelligent Graphics Controller 20, Nth Engine/150, SOTA 340i, and Vermont Cobra Plus graphics adapters could not run our VGA benchmark tests. These products employ VGA pass-through and must therefore utilize our test-bed Compaq's video electronics.

CONTINUES

PERFORMANCE TESTS: 1,024-BY-768 COPROCESSED GRAPHICS ADAPTERS

The driver more than the coprocessor determined *AutoCAD* performance. The fastest *AutoCAD* boards on the important regeneration tests, for example, were all based on the Texas Instruments TMS34010 coprocessor.

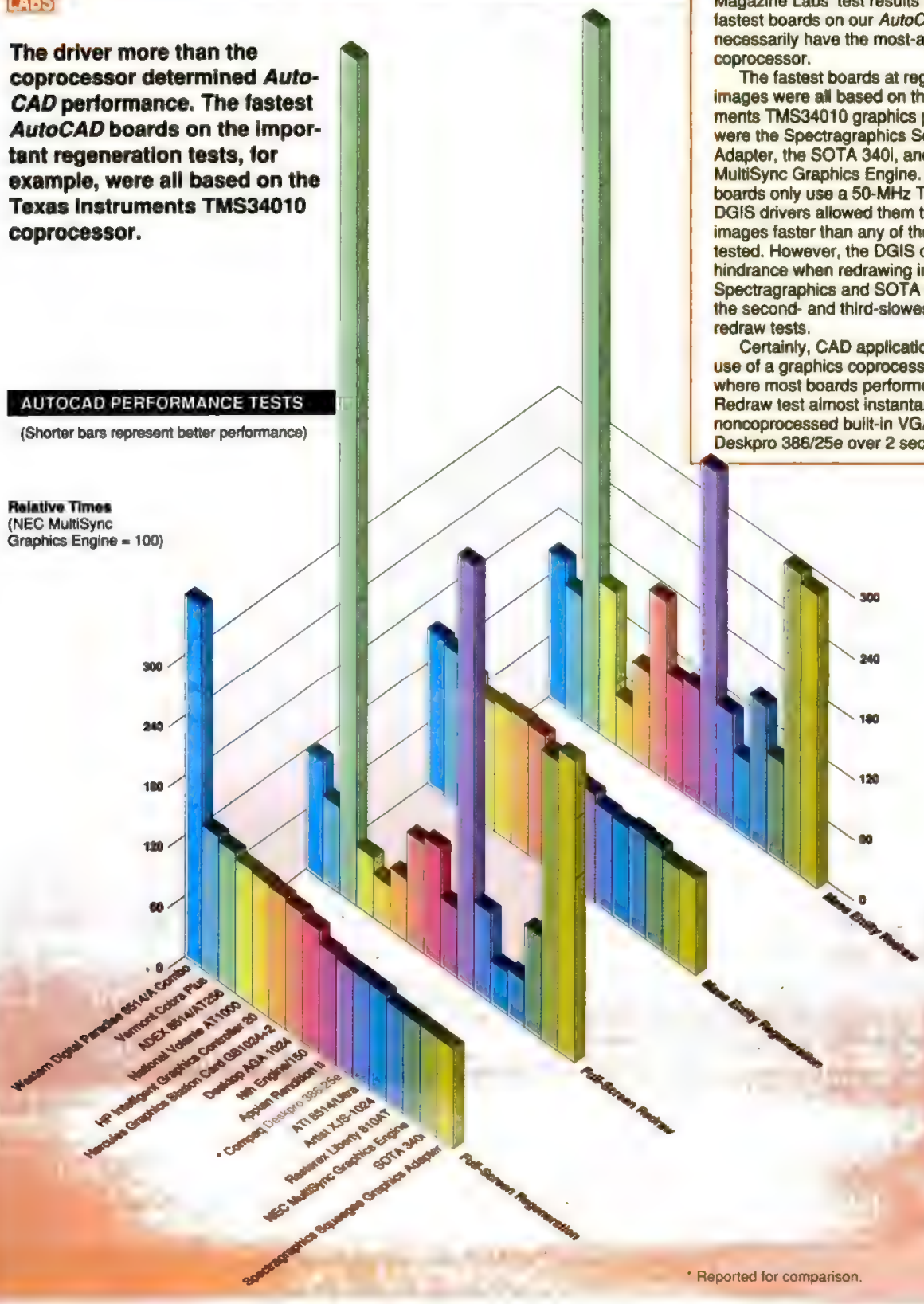
Board performance under *AutoCAD* depends more on the driver than the board. As PC Magazine Labs' test results indicate, the fastest boards on our *AutoCAD* tests do not necessarily have the most-advanced graphics coprocessor.

The fastest boards at regenerating our test images were all based on the Texas Instruments TMS34010 graphics processor. These were the Spectragraphics Squeegee Graphics Adapter, the SOTA 340i, and the NEC MultiSync Graphics Engine. While these three boards only use a 50-MHz TMS34010, their DGIS drivers allowed them to regenerate images faster than any of the other boards tested. However, the DGIS driver proved a hindrance when redrawing images, as the Spectragraphics and SOTA boards turned in the second- and third-slowest times for the redraw tests.

Certainly, CAD applications can make good use of a graphics coprocessor. For instance, where most boards performed the Full-Screen Redraw test almost instantaneously, it took the noncoprocessed built-in VGA of the Compaq Deskpro 386/25e over 2 seconds to perform

AUTOCAD PERFORMANCE TESTS

(Shorter bars represent better performance)



* Reported for comparison.

the same task at a lower resolution.

With few exceptions, regeneration performance is almost constant across all the products. Since image regeneration requires vector recalculation that involves the math coprocessor and its CPU interface, it presents a bottleneck beyond the control of board designers. The Western Digital Paradise 8514/A Combo is a prime example of this bottleneck: It had markedly slower performance on the Full-Screen Regeneration test than any of the other products reviewed.

The only other performance anomaly involved the ADEX 8514/AT256. Based on the same 8514 chip set as the Western Digital adapter, it had markedly better Full-Screen Regeneration performance. However, its redraw performance was notably worse. While ADEX has apparently solved the image-regeneration problem for this chip set/driver combination, it seems to have done so at the expense of redraw performance.

■ The **Full-Screen Regeneration** test measures the time it takes to regenerate an on-screen .DXF file containing a number of bubblelike entities. Timing begins when the test invokes the Regen command and ends when the image has completely reappeared.

■ The **Full-Screen Redraw** test uses *AutoCAD*'s Redraw command to redraw the multiple-entity screen. Timing begins when the test invokes the command and ends when the image has completely reappeared.

■ The **Mass Entity Regeneration** test measures the time it takes to regenerate an on-screen .DXF file that represents a single entity (multiple wireframe views of a single engineering model). Timing begins when the test invokes the Regen command and ends when the image has completely reappeared.

The **Mass Entity Redraw** test uses *AutoCAD*'s Redraw command to redraw the single-entity screen. This command throws the contents of a memory buffer onto the screen; the image appears faster but is less precise than when the Regen command is used. Timing begins when the test invokes the command and ends when the image has completely reappeared.

AUTOCAD PERFORMANCE TESTS

(Lower scores represent better performance)

	Full-Screen Regeneration Elapsed Time (seconds)	Full-Screen Redraw Elapsed Time (seconds)	Mass Entity Regeneration Elapsed Time (seconds)	Mass Entity Redraw Elapsed Time (seconds)
Western Digital Paradise 8514/A Combo	32.97	0.67	3.50	0.32
Vermont Cobra Plus	13.07	0.48	3.41	0.27
ADEX 8514/AT256	12.64	4.68	3.17	1.53
National Volante AT1000	12.09	0.33	2.87	0.33
HP Intelligent Graphics Controller 20	11.96	0.24	2.95	0.11
Hercules Graphics Station Card GB1024+2	11.84	0.34	2.99	0.21
Desktop AGA 1024	11.53	0.61	2.95	0.39
Nth Engine/150	11.11	0.65	2.69	0.24
Appian Rendition II	9.92	0.38	2.46	0.25
* Compaq Deskpro 386/25e	9.65	2.35	2.44	0.75
ATI 8514/Ultra	9.65	0.49	2.27	0.25
Artist XJS-1024	9.61	0.23	2.22	0.17
Rasterex Liberty 810AT	9.19	0.25	2.31	0.32
NEC MultiSync Graphics Engine	9.18	0.56	2.27	0.22
SOTA 340i	9.16	1.60	2.09	0.66
Spectragraphics Squeegee Graphics Adapter	9.13	1.67	2.13	0.64

* Reported for comparison.

ENDS

HEWLETT-PACKARD CO.

HP Intelligent Graphics Controller 20

by Winn L. Rosch

The intelligence of Hewlett-Packard's Intelligent Graphics Controller 20 ostensibly lies in its 30-MHz TI TMS34020 graphics coprocessor. But the real intelligence may be your own in selecting the product; it proved to be one of the easiest to install and the fastest in operation. Its flaws are few, and the rewards of using it are great—something you have a right to expect for $2,499.

The IGC-20 has no built-in text abilities and doesn't display any image of less than 1,024 by 768 pixels (at a 60-Hz vertical refresh rate) on its own. On the other hand, it stretches all the way to 1,280 by 1,024 pixels and displays 256 colors on-screen from a palette of 16.7 million in any mode. The full-length full-height 16-bit ISA card comes standard with 1MB of 100-nanosecond VRAM on-board; sockets accommodate a second megabyte in increments of 512K. The IGC-20 board also accommodates up to 3MB of DRAM for display-list processing.

The IGC-20 does not support on-board VGA, so you must have a VGA adapter installed in order to work with DOS. Its VGA pass-through system is unusual: Instead of going through the feature connector, the VGA signals are exchanged externally through an HP-supplied 9-inch cable that runs from the 15-pin output connector of your VGA adapter to a 9-pin D-shell connector on the back of the IGC-20. While this scheme clutters up the back of your PC, it allows the IGC-20 to work with VGA sources that lack standard feature connectors. Hewlett-Packard also throws in an adapter cable terminating in five BNC connectors for use with high-resolution display monitors that don't

FACT FILE

HP Intelligent Graphics Controller 20
Hewlett-Packard Co., 19310 Pruneridge Ave., Cupertino, CA 95014; 800-752-0900.
List Price: With 1MB VRAM, $2,499. 512K DRAM upgrade, $225; 512K VRAM upgrade, $400.
In Short: If you don't choke over the price, HP's IGC-20 delivered excellent performance and a high ease-of-use factor.

CIRCLE 618 ON READER SERVICE CARD

accept the standard VGA connectors.

Setting up the IGC-20 proved easy due to HP's automatic installation program, which works well. Its only shortcoming is its assumption that you use chiefly HP products. Selecting a monitor means guessing which HP model number comes closest to your display. Also, the documentation has a tentative look—a sheaf of photocopied sheets—but this is forgivable as you should be able to get through the setup process on your own. A three-bank DIP switch, accessible through the card-retaining bracket, is the only thing you will have to adjust.

With the board, HP supplies DGIS (for *Microsoft Windows* 3.0) and TIGA (for *AutoCAD*) drivers plus a custom driver for GEM applications such as *Ventura Publisher*. Both real-mode and protected-mode display list drivers are available for *AutoCAD*. The performance of the IGC-20 is exemplary. *AutoCAD* redraws were so quick that timing them proved meaningless: The board was faster than the reviewer's reaction time. And its quick race through PC Magazine Labs' *Windows* benchmark tests proved the IGC-20's excellent results stemmed from its power and not the deterioration of the aging reviewer's reflexes.

Amid a sea of troublesome installations and incompatibilities, the IGC-20 stands out as a quick and well-engineered performer, though a costly one. If you are looking for a coprocessed graphics adapter, this board is a smart choice.

NATIONAL DESIGN INC.

National Volante AT1000

by Tom Unger

National Design's $995 Volante AT1000 represents a new wave of high-performance, low-cost TIGA adapters with on-board VGA capabilities. We liked the AT1000 when we reviewed it in our First Looks section earlier this year (*PC Magazine*, January 29, 1991). Its superior performance in both TIGA and VGA modes and useful upgrade options make it a top contender in this review group as well.

The National Volante AT1000 and its non-VGA cousin, the AT1200, are the babies in a family of high-performance boards manufactured by NDI for CAD, desktop publishing, and other graphics-intensive tasks. (The same board is available as the VGS-20 from Liberty Electronics, South San Francisco, California; 415-742-7000.) The full-length 16-bit ISA adapter allows both noninterlaced and interlaced video in TIGA mode at resolutions up to 1,024 by 768 pixels with 256 simultaneously displayed colors. Based on a second-generation TI TMS34020 graphics coprocessor, it comes equipped with 512K of frame-buffer DRAM and 1MB of VRAM expandable to a maximum of 4MB.

The AT1000's on-board ET4000 VGA chip set from Tseng Laboratories handles all VGA and lower emulations, and it supports up to 1,024-by-768 256-color Super VGA resolution as well. The VGA portion of the board uses its own 512K of fast DRAM, expandable to 1.5MB; it was consistently the fastest or second fastest on our 1,024-by-768 VGA tests and was the only one of these high-resolution contenders that performed the VGA hardware-compatibility tests faster than our test-bed Compaq Deskpro 25e's built-in display circuitry.

Among the AT1000's most notable features is an on-board loop-through connector for attachment to NTSC-compatible video-capture boards, useful for creating multimedia presentations with authoring software that can handle television-quality video input. Both the AT1000 and the AT1200 have sockets for a TMS34082 floating-point coprocessor, which lends additional graphics processing performance in extremely complex high-end operations such as 2-D and 3-D convolutions, 4-by-4 matrix operations, and cubic splines.

Installation and setup are simple, with a straightforward utility that shows you the proper board-level DIP switch settings for your hardware and then takes you through installation of both the TIGA and *Microsoft Windows* 3.0 drivers for the TI TMS34020 chip. The excellent manual describes the procedure for adjusting your *Windows* SETUP program's characteristics for 1,024-by-768 TIGA operation, while the installation program for the optional ($95) protected-mode *AutoCAD* display-list driver for TIGA devices clearly outlines the few steps necessary to load the environment variables. This driver markedly improved the speed of redraws and regenerations; on our tests, the AT1000's TIGA performance was average in this respect.

FACT FILE

EDITORS' CHOICE

National Volante AT1000
National Design Inc., 9171 Capital of Texas Hwy., Houston Building, #230, Austin, TX 78759; 512-343-5055.
List Price: With 512K DRAM, 1MB VRAM, $995
In Short: The National Volante AT1000 did respectably on the high-resolution tests, excellently on the VGA tests, and came well-configured (including on-board VGA) for a strongly competitive price.

CIRCLE 619 ON READER SERVICE CARD

National Design offers a lifetime warranty for parts and labor. It provides free telephone-technical assistance during business hours (Central time) plus a 24-hour BBS with updated software drivers, though neither line is toll-free.

The National Volante AT1000 showed good speed in TIGA mode and superior VGA performance at an exceptional price, all of which make it an attractive buy for the performance-hungry Super VGA crowd as well as more-traditional high-end graphics users. Add into this equation its lifetime warranty and upgrade options and you have a 1,024-by-768 board worth serious consideration for any high-end workstation.

NTH GRAPHICS LTD.

Nth Engine/150

by M. David Stone

The Nth Engine/150 from Nth Graphics is one of several boards that are breathing life into the 8514/A standard, which IBM has all but abandoned. Built around the Chips and Technologies version of the 8514/A chip set, the board offers register-level compatibility with IBM's 8514/A, a variety of drivers, upgrade options, and good-enough performance to justify its $1,695 price.

Our evaluation version of the Nth Engine/150 came with 2MB of VRAM and the ability to display 256 colors simultaneously from a palette of 16.7 million; by the time you read this, it should be shipping with only 1MB of VRAM (according to Nth Graphics, there is no performance difference between the two). A $1,495 version of the board with 512K of VRAM supports 16 simultaneous colors

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- **Finalist, *PC Magazine* Award for Technical Excellence, 1990**
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PC Magazine, December 25, 1990

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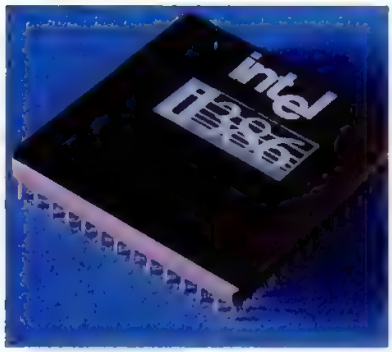

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You'll see **CompuAdd-exclusive "hot slots"**: two 16-bit expansion slots designed to maximize the performance of the CompuAdd HardCache/ESDI controller card and CompuAdd Hi-Rez VGA card. (Each slot still works perfectly with a standard 16-bit expansion card, should you choose that option.) And you'll see a motherboard designed by CompuAdd to take maximum advantage of the optional, ultra fast SRAM card.

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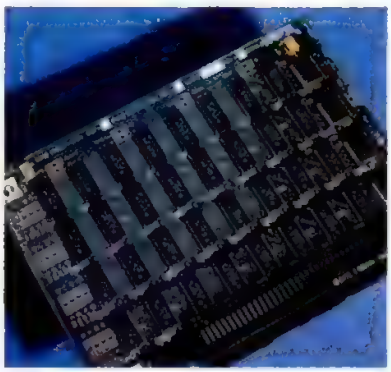

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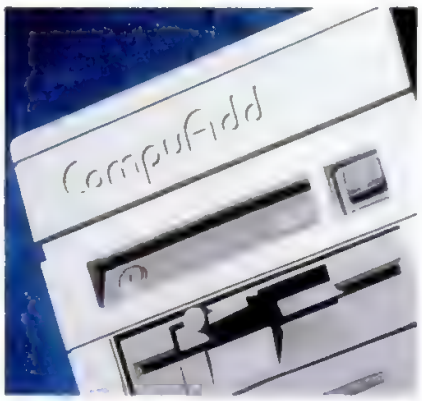

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PC MAGAZINE EDITORS' CHOICE December 25, 1990 CompuAdd 333T

CompuAdd 333T: Best Overall Performance

1990 - FINALIST - PC Magazine Award for Technical Excellence

PCS CompuAdd 333 and 333T CompuAdd Corp

CompuAdd 333T
The 333T is a proven winner, picked as Editors' Choice in *PC Magazine*, December 25, 1990! And picked as a finalist for *PC Magazine's* 1990 PC Technical Excellence award! It's the *fastest 33MHz 386 system you can buy* — as determined by top scores on seven of nine PC Labs benchmarks. In selecting the 333T as Editors' Choice, the editors credited the CompuAdd 333T with "the best overall performance in the field."

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333 80MB	*66667* - $3195	*66668* - $3675
333 200MB	*66670* - $3595	*66671* - $4075

* CompuAdd High-Resolution VGA (1024x768) monitor with CompuAdd Hi-Rez VGA card and 1MB RAM.

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FACT FILE

Nth Engine/150
Nth Graphics Ltd., 1908 Kramer Ln., #A, Austin, TX 78758; 512-832-1944.
List Price: With 2MB VRAM, $1,695. 256-color 1,280-by-1,024 noninterlaced version, $1,995.
In Short: This 8514 work-alike isn't such a hot buy if all you are interested in is 1,024 by 768. But if you require some of its special features or might need 1,280 by 1,024 later, the Nth Engine/150 might be a good investment.

CIRCLE 620 ON READER SERVICE CARD

from a palette of 4,096 at the same resolution. Two higher-end variations—one that supports 1,280-by-1,024 noninterlaced resolution and another for 1,024-by-768 interlaced and noninterlaced modes—are also available; the 16-color version costs $1,795, and the 256-color version will run you $1,995. You can upgrade by swapping any of these boards for a more expensive version, paying Nth Graphics only the difference in price. All four versions support VGA only by a pass-through connection; Nth Graphics says that a VGA daughtercard is currently under development.

Setting up the Nth Engine/150 is mostly plug and play: Put the board in any 16-bit slot, connect the supplied VGA pass-through ribbon cable, and plug an appropriate monitor into the high-density 15-pin connector. Installing the software is almost as easy. For use with *Microsoft Windows* 3.0, the board relies on the Microsoft 8514/A driver. When left alone, this driver puts the board into interlaced mode, but you can get around this by using an Nth Graphics–supplied utility that forces the board into noninterlaced mode. By the time you read this, Nth Graphics should have a driver to run *Windows* at 1,280-by-1,024 resolution.

For CAD applications, Nth Graphics supplies either an *AutoCAD* or *VersaCAD* version of its own display-list processing software. Both versions of *Nth Drive* are available for any VGA or 8514/A adapter for $595 each. The Nth Engine/150 price includes your choice of either package; add $295 if you need both. Return certificates in the box entitle you to free *AutoShade* 2.0 and *AutoDesk 3D Studio* drivers on request, plus *Hydra View/AC*, which works inside *AutoCAD* 11 and lets you interactively view and manipulate 3-D models.

Though all four of the Nth Graphics boards mentioned here include a mouse port (which frees a slot or communications port otherwise monopolized by a mouse), they do not come with a mouse driver; Nth Graphics assumes you received a driver when you purchased your mouse. The mouse port works with either a serial or bus mouse and also supports digitizing tablets such as Summagraphics's SummaSketch or Hitachi America's Tiger Tablet.

The Nth Engine/150 performed well on PC Magazine Labs' performance tests. It scored average or better on the *AutoCAD* tests and in the first or second tier for every *Windows* test. In fact, on the *Windows* test suite, it edged out its two 8514 work-alike competitors (the ADEX 8514/AT256 and Western Digital Paradise 8514/A Combo) due to its Chips and Technologies 82C480 8514 controller. Two of the three boards that consistently outperformed it are also substantially more expensive.

If all you want is 1,024-by-768 resolution in a *Windows* or *AutoCAD* environment, you can find better buys than the Nth Engine/150. But if you can use the additional drivers and special features it supports, or if you think you might want to upgrade later to 1,280-by-1,024 resolution, the Nth Engine/150 is a good investment consideration.

NEC TECHNOLOGIES INC.

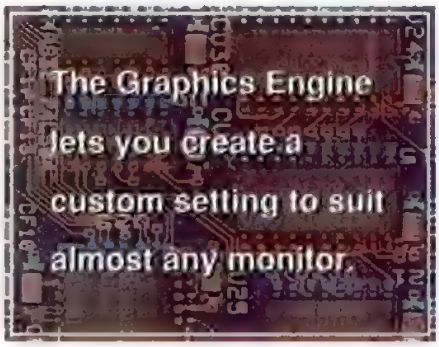
NEC MultiSync Graphics Engine

by Alfred Poor

NEC helped multifrequency monitors bloom on the PC landscape with their original MultiSync monitor. The company has continued to help beautify desk displays through their high-resolution display adapter, the MultiSync Graphics Engine. The Graphics Engine has its faults, which includes average speed, but these are more than offset by good software support and its ability to work with just about any monitor.

The Graphics Engine is built around a 50-MHz TI TMS34010 graphics coprocessor and also includes VGA adapter circuitry on-board. The $999 version comes with 512K of VRAM and can simultaneously display 16 colors at 1,024-by-768 resolution. For a list price of $1,499, you can also get a version with 1MB of VRAM,which can simultaneously display 256 colors at that resolution. Both models come with 768K of DRAM.

One of the most important aspects of this product is its unprecedented flexibility. The Graphics Engine and its setup software come configured to work with the various NEC monitors, but you can create a custom setting to suit just about any monitor. You will need to know some



esoteric details about your monitor, such as the timings for the horizontal front porch, sync signal, and back porch, which you can usually find in the back of your monitor's user manual. With luck, your monitor will be able to sync on a preconfigured signal, and you will never have to use this feature, but it is a priceless option if you need to salvage your investment in an expensive tube.

Assuming your monitor takes a standard signal, installation is fairly easy. The Graphics Engine requires a 16-bit ISA slot, and aside from having to set one jumper for some monitors, you can simply swap it for your existing display adapter. The software installs itself via a utility program, which has one glitch. The install program created an AUTOEXEC .BAT file with a syntax error; not a grave one, but one that might take a novice quite a while to debug.

The Graphics Engine card produces a

FACT FILE

NEC MultiSync Graphics Engine
NEC Technologies Inc., 1255 Michael Dr., Wood Dale, IL 60191; 800-826-2255.
List Price: With 768K DRAM, 1MB VRAM, $1,499.
In Short: Though not a performance standout, the NEC MultiSync Graphics Engine is broadly supported and can regularly be found at significant price discounts.

CIRCLE 621 ON READER SERVICE CARD

noticeable amount of heat when operating; you will want to make doubly certain that it is as ventilated as possible inside your computer's case. Its performance, however, was not particularly hot. Though better than average on the *AutoCAD* tests, the Graphics Engine was not at the top of the list. Its *Windows* results were comparatively undistinguished, though it beat most of its TMS34010 competition on the Screen-to-Screen BitBlt and Memory-to-Screen BitBlt tests. And while it also managed to hold its own on the Random Rectangles test, its VGA scores were consistently disappointing.

On the other hand, you won't be disappointed by its driver support. A host of drivers are included in the package, including *AutoCAD*, *GEM*, *Windows*, and *WordPerfect*. The product supports both the DGIS and GSS*CGI graphics-control languages, which are supported by a wide range of popular programs (such as *Harvard Graphics* and many CAD packages). The card does not have a protected-mode driver for *AutoCAD*, though; you must choose between a display-list driver that requires expanded memory or no display-list support.

With a broad distribution channel, you can easily find significant discounts of a third or more off the list price. When you take into account its street price plus its ability to reprogram signal timings, the Graphics Engine has a lot to offer.

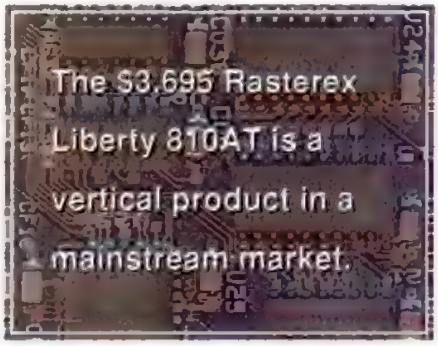
RASTEREX USA/EXPERT GRAPHICS

Rasterex Liberty 810AT

by Kellyn S. Betts

In many ways, the Rasterex high-resolution video board represents a bygone era; it is a vertical product in what has become a mainstream market. At $3,695, the Rasterex Liberty 810AT is the most expensive board in this lineup. Its combination of two coprocessors in conjunction with its custom drivers ensures you good *AutoCAD* performance, but the bugginess of its built-in VGA is a serious drawback for the general run of users.

The Liberty 810AT is but one of a two-year-old line of eight (four 16-bit ISA and four MCA) TI TMS34010-based boards. These boards are manufactured by the five-year-old Norwegian company, Rasterex, through its sole U.S. distributor, Atlanta-based Expert Graphics. These Liberty boards range in price from $2,995 to $4,595; all start from the same base price and add varying amounts and combinations of memory and programmable logic array chips (PALs). The second custom coprocessor on these boards is called the Octopus coprocessor. Designed to accelerate vector drawing, this co-coprocessor is currently used only by the company's *AutoCAD* driver. Our evaluation unit came with 1MB of 80-nanosecond VRAM for display purposes and



1MB of DRAM for holding display lists and other duties. It can simultaneously display 256 colors from a palette of 16.7 million at resolutions up to 1,024 by 768 pixels.

Rasterex recently added a second line of high-resolution graphics boards to its offerings. Bearing the name Light, the half-length boards in this line range in price from $1,745 to $2,345, are also built around the TI TMS34010 chip, and come with Rasterex's custom *AutoCAD*-enhancement software. All boards in the Light and Liberty lines are field upgradable by the company's authorized dealers and feature the same one-year parts-and-labor warranty.

The *AutoIcon* software bundled with the Rasterex board replaces *AutoCAD*'s graphics tablet with on-screen icon menus. Drivers for additional CAD applications (usually priced lower than $100) are available for additional fees through the company's dealers or its bulletin board. The proprietary *AutoCAD* driver in *AutoIcon* took advantage of the board's Octopus coprocessor and posted good performance times, especially in the regeneration tests. It has a generic TIGA driver for *Microsoft Windows* 3.0 and *GEM*, as well as a driver for *Ventura Publisher;* the TIGA driver performed on a par with other TIGA drivers.

PC FACT FILE

Rasterex Liberty 810AT
Rasterex USA/Expert Graphics, 1908 Cliff Valley Way, #2010, Atlanta, GA 30329; 800-648-7249, 404-320-0800.
List Price: With 1MB DRAM, 1MB VRAM, $3,695.
In Short: The Liberty 810AT delivered good *AutoCAD* performance, but it suffered from bug-ridden built-in VGA and an unattractive price.

CIRCLE 622 ON READER SERVICE CARD

Unfortunately, the built-in VGA controller did not perform nearly as well. It finished in the lower half on no less than five of our VGA hardware compatibility tests, and it proved unable to run *Microsoft Windows* 3.0 at VGA resolution. Though its high-resolution (1,024 by 768) *Windows* driver worked acceptably well, the card's jerky performance when running DOS will make you glad that it offers a VGA pass-through option as well. Its VGA speed does not compare well with that of boards dedicated to generating IBM-standard 640-by-480 signals, as the Rasterex circuitry is addressed only by an 8-bit I/O channel.

While the Rasterex Liberty 810AT can regenerate and redraw *AutoCAD* renderings quickly, the fact that you must pay dearly for a board with buggy built-in VGA makes it hard to recommend it for other purposes. You will find it difficult to overlook its shortcomings in price and performance.

SOTA TECHNOLOGY INC.

SOTA 340i

by Kellyn S. Betts

What a difference a manual can make! The SOTA 340i, which is moderately priced, is a well-performing high-resolution video card based around the TI TMS34010 coprocessor. But those qualities come to naught if you can't figure out how to get a product up and running.

The SOTA 340i is attractively priced. The reviewed version containing 1MB of 100-nanosecond VRAM and 512K of DRAM lists for $995. From a palette of 16.7 million colors, it can simultaneously display 256 colors at 1,024-by-768 noninterlaced resolution or 16 colors at 1,280-by-1,024 interlaced resolution. A $795 version of the card includes but 512K of

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*Average speed based on PC Magazines's WINBENCH V1.1 Windows benchmark test. Results available upon request. **Suggested retail price for 512K model. 1MB versions also available. Dealers may sell for less.
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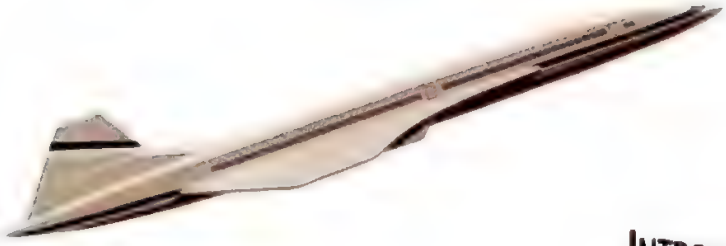

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Co-Processor	80C287 socket	80387SX socket	80387SX socket	Upgradeable to i486 20MHz	Integrated
Memory (Std./Max.)	1MB/2MB	2MB/4MB	2MB/8MB (64K cache)	4MB/16MB	4MB/16MB
Hard Disk Drive	30MB	60MB	60MB	120MB	120MB
LCD/Size	Backlit/8.85"	Backlit/8.85"	Backlit/8.85"	Edgelit/10.7"	Edgelit/10.7"
Video/Gray Scales	VGA/16	VGA/16	VGA/32	VGA/64	VGA/64
Power Management	• Suspend/Resume • Sleep mode • Low battery operation	• Suspend/Resume • Sleep mode • Low battery operation	*Premier System Management™* • Standby/Resume • Rest/Resume • Panic Save • Unattended communications	*Intelligent Power Management™*	*Intelligent Power Management*
Software	MS-DOS® included	MS-DOS included	MS-DOS pre-installed, Microsoft® *Windows*™ v.3.0 included	MS-DOS and Microsoft *Windows* v.3.0 pre-installed	MS-DOS and Microsoft *Windows* v.3.0 pre-installed
Weight (with battery)	6.6 lbs.	6.6 lbs.	6.8 lbs.	15 lbs.	15 lbs.

ZENITH data systems

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CIRCLE 732 ON READER SERVICE CARD

VRAM, and a $295 CAD daughtercard option allows either of these main cards to display at 1,280-by-1,024 noninterlaced resolution. SOTA also sells straight VGA cards to which the higher-end cards can pass signals. All these boards are sold through dealers and distributors and come with a generous five-year parts-and-labor warranty.

At the time of our review, SOTA Technology spokespeople stated they were waiting for a new TIGA driver from Texas Instruments and realized that in the interim, they were selling the SOTA 340i boards with inadequate documentation. As a result, nothing in the product's outdated manual really describes how to install the board. The installation software did not work properly, and there weren't any READ.ME files to explain which of the many DGIS and TIGA drivers the supported software requires or how to load the drivers so they would not interfere with one another. We were able to install the board and software only with the help of the company's technical support staff, which is reachable through an 800 line. SOTA says it will offer the phone installation aid to all customers until the documentation is updated, but the process would be far simpler for all concerned if it was documented.

Once we installed the software and ironed out a few bugs, the DGIS driver for *AutoCAD*, Release 10, and the TIGA driver for *Microsoft Windows* 3.0 that come with the board worked well enough. The *AutoCAD* driver posted some of the fastest regeneration times of the pack, though its redraw times were slower than average, and its *Windows* times were middle-range.

By the time this review is in print, SOTA promises that its manual will be up to date, and the company expects to have a faster *Windows* driver by that time as well. If we could have reviewed the documentation drivers, we might be able to recommend this board more highly. As it is, we can only advise you to steer clear of it while noting the potential its low price, decent performance, and long warranty might offer.

FACT FILE

SOTA 340I
SOTA Technology Inc., 559 Weddell Dr., Sunnyvale, CA 94089; 800-933-7682, 408-745-1111.
List Price: With 512K DRAM, 1MB VRAM, $995. CAD daughtercard, $295.
In Short: The SOTA 340i has a good price, but it was hurt by poor documentation and only adequate performance.

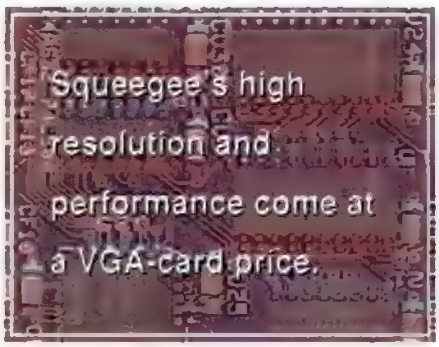
CIRCLE 623 ON READER SERVICE CARD

SPECTRAGRAPHICS CORP.

Spectragraphics Squeegee Graphics Adapter

by Kellyn S. Betts

Spectragraphics' new coprocessed board offers high resolution and coprocessor performance at a price one is more likely to associate with VGA cards. The 16-simultaneous-color version of the card costs a mere $595; a daughtercard with 1MB of VRAM for a 256-color display (from a palette of 256,000 colors) costs an additional $250, while $195 on top of that buys a VGA daughtercard. No matter what combination you buy, you are getting a good deal.



Squeegee is so named because Spectragraphics is aiming this product at *Microsoft Windows* 3.0 users. In addition to a custom *Windows* driver, there are seven other drivers shipped with the product: *AutoCAD*, *AutoShade*, *AutoSketch*, *DrawPerfect*, *GEM*, *Ventura Publisher*, and *WordPerfect;* a Presentation Manager driver and other driver updates are available through the company's bulletin board. All the drivers use the DGIS interface originally created by GSS, Spectragraphics's parent company. The company offers MCA versions of its Squeegee cards for slightly higher prices.

Our $845 tested unit and its drivers turned in respectable midrange times on our *Windows* performance tests. On our *AutoCAD* tests, the board did well on regeneration but poorly on redraw. The VGA daughtercard had a few compatibility problems with direct writes to the frame buffer but otherwise did well enough on our tests. The Squeegee Graphics Adapter also offers a pass-through VGA option (and it even comes with the requisite pass-through cable), so you can easily bypass this minor compatibility problem.

The company's setup, service, and support are more than reasonable for such a low-priced product. The board and software are nicely packaged and easy to install, thanks to a thorough if not particularly technical manual. There is a one-year parts-and-labor warranty, backed up by an 800 technical support line, a bulletin board, and a 30-day unconditional money-back offer.

If you want to display *Windows* at a high resolution without losing too much display speed—or money—the Squeegee Graphics Adapter is an attractive way to expand your vision.

FACT FILE

Spectragraphics Squeegee Graphics Adapter
Spectragraphics Corp., GSS Personal Graphics Div., 9590 SW Gemini Dr., Beaverton, OR 97005; 800-800-9599, 503-641-2200.
List Price: With 512K DRAM, 512K VRAM, $595. VGA daughtercard, $195.
In Short: Though suffering from a few VGA problems, the Squeegee performed well and has a strongly competitive price.

CIRCLE 624 ON READER SERVICE CARD

VERMONT MICROSYSTEMS INC.

Vermont Cobra Plus

by Kellyn S. Betts

Like many older high-end video cards, the Vermont Cobra Plus is intended for PC-based CAD users, and as is appropriate for a product designed for an audience whose overriding concern is speed, this TI TMS34010–based board (which does not have VGA on-board) is quick. Unfortunately, it is also expensive; the 256-simultaneous-color version we reviewed cost $2,695, though you can get a 16-color version identical to the one we reviewed last year ("1024 Graphics Adapters," *PC Magazine*, April 10, 1990) for only $1,495.

One reason the Cobra Plus costs so much, according to Vermont Microsystems, is because of the expenses associ-

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CIRCLE 192 ON READER SERVICE CARD

ated with the company's commitment to support a wide range of microcomputer-based CAD software. The board includes *AutoCAD* enhancement software called *AutoMate/Pro*, which simplifies hardware pans and zooms by displaying a full view of drawings within a pop-up window, provides anti-aliasing, and allows the user to control regeneration. The board also boasts nearly 50 drivers, and the company claims compatibility with 200 software packages, 40 of which are CAD packages. The package comes with ten drivers (including *AutoCAD*, Releases 10 and 11; *GEM; Microsoft Windows* 3.0; and *Ventura Publisher*) included on the distribution disks; the rest are available by mail or through the company bulletin board.

The drivers that we tested performed well. The company's *AutoCAD* driver posted fast redraw times, though its regeneration times, which are arguably more important to CAD users because they represent the time required to calculate the vectors in drawings, were slower than those of most of the other packages. The performance of its TIGA 2.0–based *Windows* driver (which a company spokesperson says is one of the few thrown in merely to humor the few users interested in more-mainstream applications) fell in the middle of the performance range, but a soon-to-be-released custom driver for *Windows* promises faster speed.

DOCUMENTATION TELLS ALL

Vermont Microsystems is to be commended for its excellent documentation. The extensive collection of manuals and leaflets that came with the board made installation of board and drivers very easy and straightforward. The company's warranty is generous: five years if the product is purchased through an authorized dealer, two years if it's purchased through some other route but verified by the company's receipt of a user registration card, and one year for all other customers.

FACT FILE

Vermont Cobra Plus
Vermont Microsystems Inc., 11 Tigan St., P.O. Box 236, Winooski, VT 05404; 802-655-2860.
List Price: With 1MB VRAM, $2,695. Separate VGA card, $250.
In Short: Though it did well on our tests, the Cobra Plus did not support on-board VGA and had an uncompetitive price.

CIRCLE 625 ON READER SERVICE CARD

By the time this review is published, however, the company's new Vermont Cobra Elite board should be available. Besides costing less, the new board promises a wealth of new features, including new *RenderReady* software the company claims will allow the board to display photo-realistic images. The promised potential of its future competitor makes the Cobra Plus board less attractive, even to CAD users. It works well, but you can do better for less money.

WESTERN DIGITAL IMAGING

Western Digital Paradise 8514/A Combo

by Alfred Poor

Western Digital's line of Paradise video adapters have long held a reputation for affordable quality. The 8514/A Combo reaches for top performance while still providing VGA support on-board, for a list price of $1,099 (you can frequently find products in this line discounted by 40 percent or more). A three-year warranty only makes the package that much more appealing.

The base-priced model comes with 512K of VRAM; our $1,398 evaluation model came with an additional 512K of VRAM, which carries a $299 list price. Using an 8514-compatible coprocessor built by Western Digital, the card supports 1,024-by-768 interlaced and noninterlaced resolutions, and it turns in some impressive performance results in 16- and 256-simultaneous-colors modes. The 8514/A driver included with *Microsoft Windows* 3.0 worked extremely well, producing above-average results on almost every test. The 8514/A Combo's performance was either average or above on our VGA tests as well, with a special advantage shown in the 256-color-mode tests.

Unfortunately, its performance falls a bit when it comes to *AutoCAD* work. While the board ships with a number of real-mode drivers for *AutoCAD*, it has none that support the *AutoCAD* protected-mode version. A Western Digital representative recommended using *AutoCAD*'s own 8514/A driver in this case, but even this produced slow performance times—except for the Full-Screen Redraw test, on which the adapter's performance was faster than average.

FACT FILE

Western Digital Paradise 8514/A Combo
Western Digital Imaging, 800 E. Middlefield Rd., Mountain View, CA 94043; 800-832-4778.
List Price: With 1MB VRAM, $1,398.
In Short: With VGA on-board and respectable performance, the 8514/A Combo's only limitations seem to be an average price and a surprising lack of support for 800-by-600 resolution.

CIRCLE 626 ON READER SERVICE CARD

Installation is fairly easy, though there is a forest of jumpers and switches on the board for selecting interrupts, bus timings, memory addresses, vertical refresh rates, composite or separate sync, and 8- or 16-bit BIOS operation. Fortunately, the factory settings work fine in most cases; when they don't, these daunting alternatives give you some hope of resolving conflicts with boards or other monitors. For example, you would prefer the 70-Hz vertical refresh rate because it reduces flicker, but a 60-Hz rate is handy if your monitor cannot handle the higher rate.

One surprising limitation of the board is its lack of an 800-by-600 Super VGA mode; your options are simply 640-by-480 or 1,024-by-768 resolutions. Also, the documentation supplied with the board is merely adequate. Getting the board to operate under *Windows* 3.0's 386 enhanced mode, for instance, requires you to add an EMMEXCLUDE line to *Windows'* SYSTEM.INI file, but the manual does not document this fact. Western Digital's tech support should be able to help you clear up such problems fairly quickly, but an index and more-complete information would certainly improve the manual.

The 8514/A Combo is proof that you do not have to spend lots of money to get top performance. If you need 1,024-by-768 displays in 16- or 256-color modes at an affordable price, the 8514/A Combo should be near the top of your list. ■

Alfred Poor, Winn L. Rosch, and M. David Stone are contributing editors of PC Magazine. *Kellyn S. Betts is a free-lance writer and a frequent contributor to* PC Magazine. *Matthew J. Ross and Tom Unger are staff editors of* PC Magazine.

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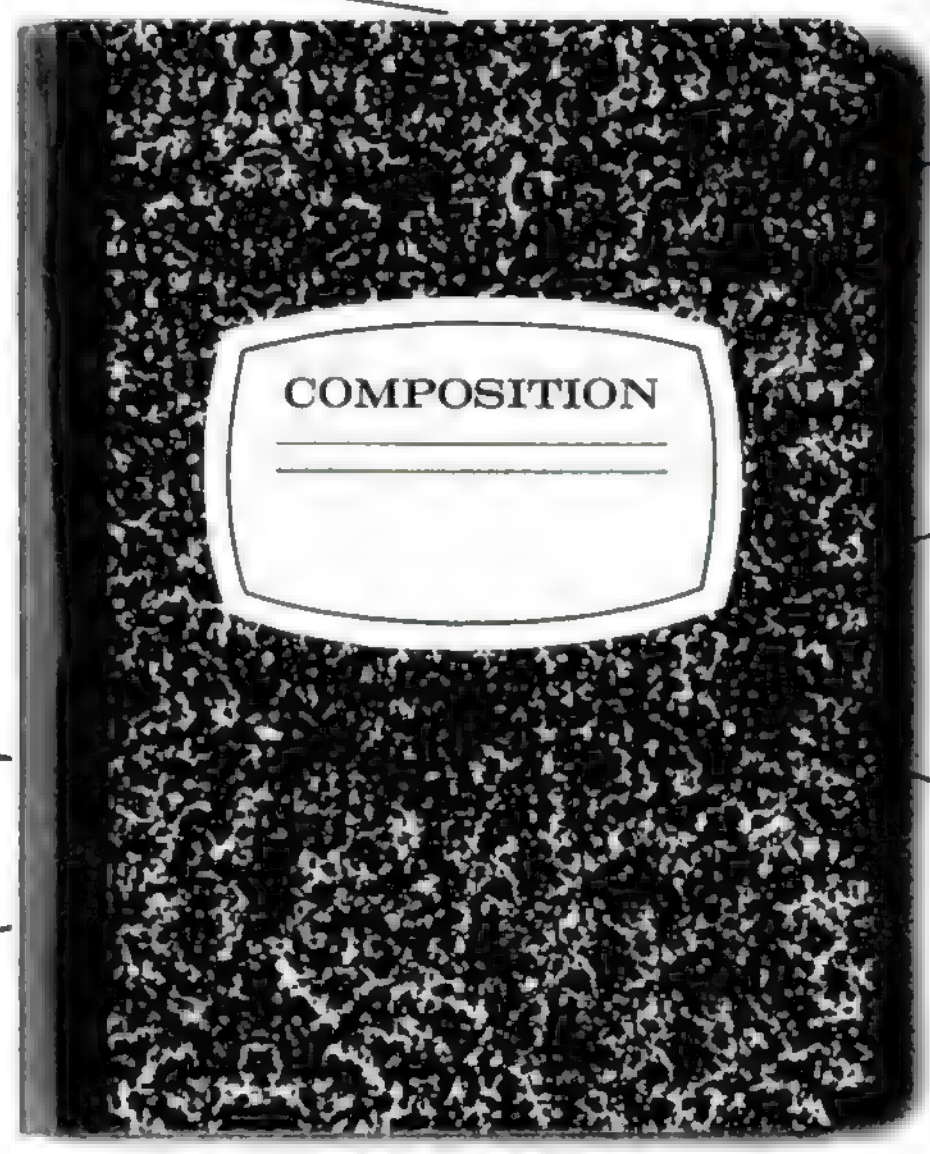

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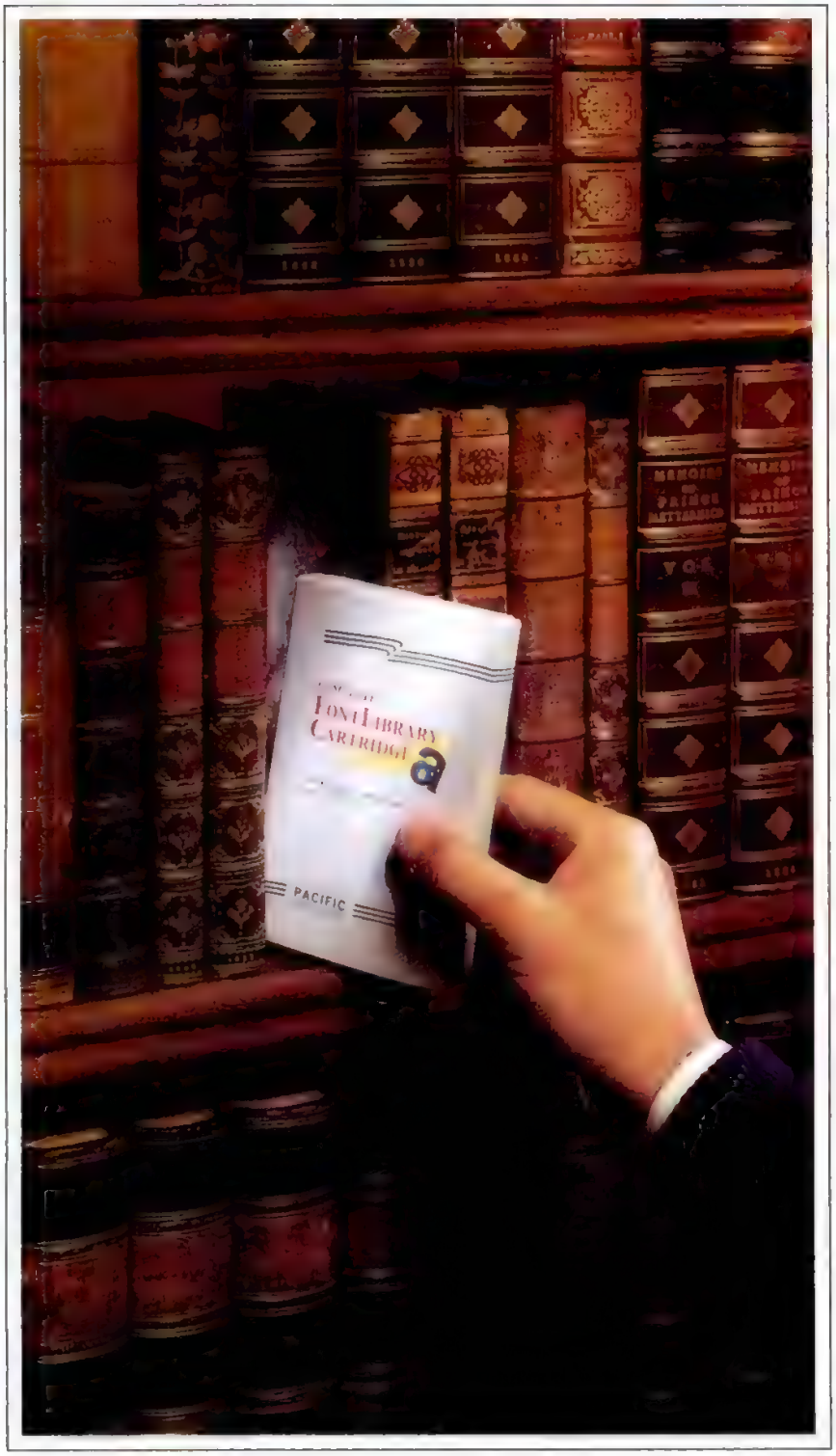

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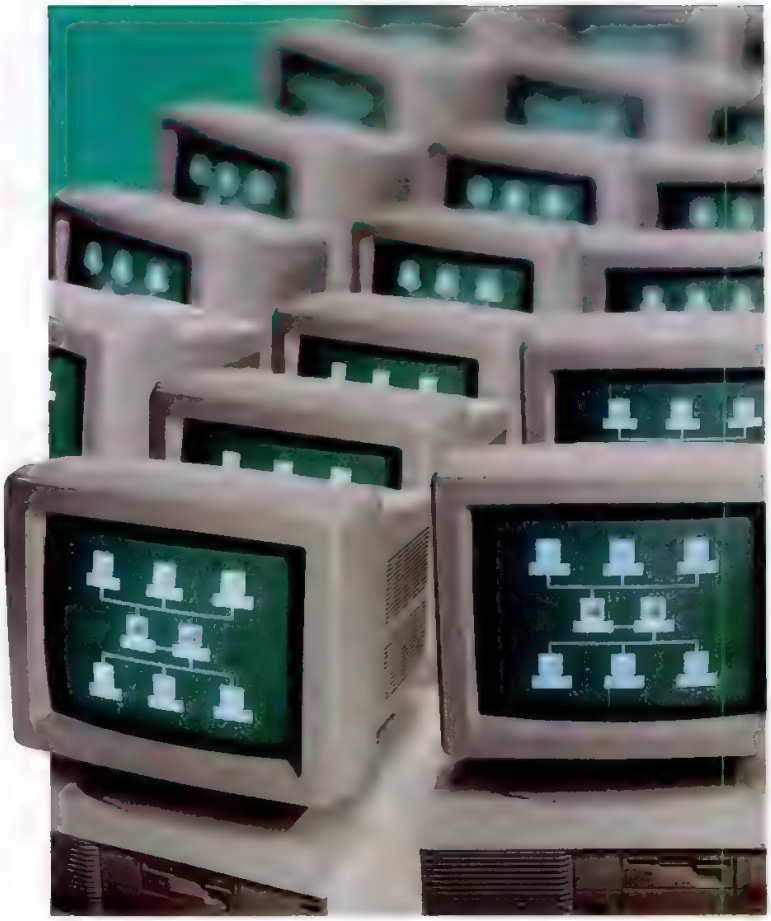
BUILDING WORKGROUP SOLUTIONS

DOS-Based LANs Grow Up



Once the solution for lower-end networks of two to ten users, today some of the top DOS-based LANs prove eminently usable on networks of a hundred PCs or more. More good news: The performance doesn't come at a high price.

PHOTOGRAPH: THOM O'CONNOR; COMPUTER ENHANCEMENTS: GOODSIGHT GRAPHICS

by Frank J. Derfler, Jr.

Get ready to give up some long-held conceptions you may have about the capabilities and usefulness of DOS-based LAN operating systems. People commonly think that DOS-based LANs are good only for network installations of two to ten PCs, but the top packages can handle hundreds of networked PCs, along with bridges, routers, gateways, and communications servers. Among the group we

TOURING THE LAN

by Frank J. Derfler, Jr.

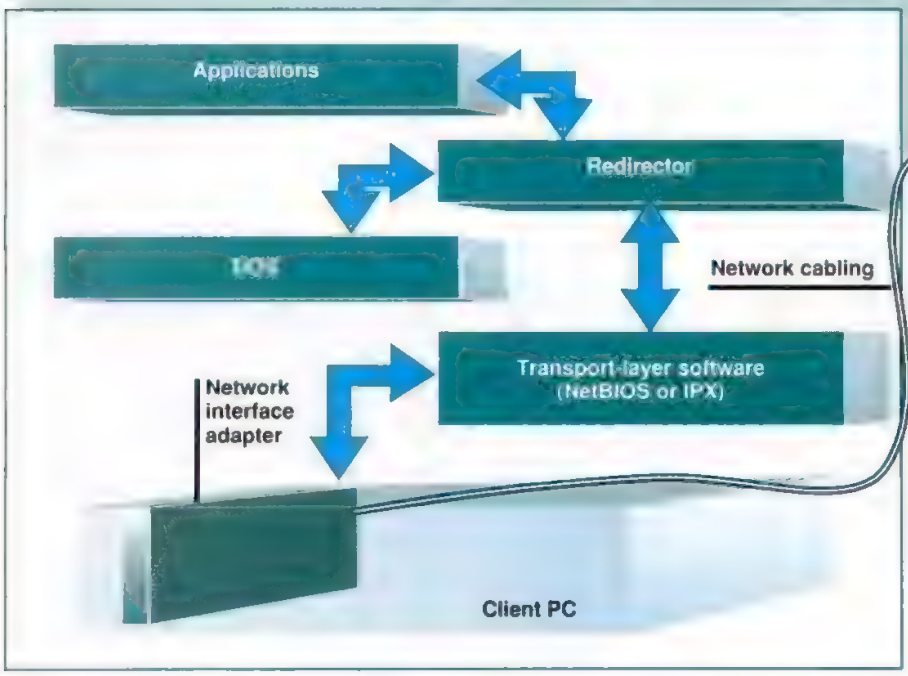
Many users considering the installation of a DOS-based LAN may be new to the world of networks. A brief tour of some of the elements and how they operate can quickly bring them up to speed.

In a PC-based network, computers act in the roles of servers and client stations. The servers make their attached disk drives, printers, modems, and unique communications links, such as fax boards, available to the client PCs. Software on the client PCs gives network users access to the data and devices on a server. The network software on the server side determines whether the server is dedicated to its service role, or also runs local application programs in what is called a peer-to-peer network. Most DOS-based LANs offer peer-to-peer functionality.

Virtually any 286-, 386-, or 486-based computer can act as a server. Organizations traditionally interested in DOS-based LANs—those with up to a dozen users—may find 286-based servers adequate, but the low price of 386 processors makes choosing 386-based servers practical. Some products we reviewed can quite capably support a hundred users on a single server; these larger installations practically demand a 386-based machine.

Network interface adapters are the most frequent investment in LAN hardware. Fortunately, increased competition has driven the price of Ethernet and ARCnet cards into the range of $200 to $250.

The network interface adapter often determines the type of cabling you'll need to connect the servers and client stations. Choices include unshielded twisted-pair telephone wire, shielded twisted-pair data-grade wire, coaxial cable, and fiber-optic cable. But if your building already has one of these types of wire installed, you'll want to select an interface card that can work with the existing installation.



reviewed are mature and powerful products that can challenge the newly released *NetWare*, Version 2.2 (which consolidates the features of *SFT NetWare*, *Advanced NetWare*, *ELS I*, and *ELS II*), and *LAN Manager* in performance, and even in total storage capacity.

Several factors—perhaps most importantly the heated competition for business in this arena—drive the significant number of improvements in performance and features. Artisoft's *LANtastic* has a longer list of features than its competitors, helping the company maintain its current lead in market share. But with aggressive competition from companies such as D-Link, Invisible Software, Performance Technology, US Sage, and others, it can't afford to stop and rest on its laurels.

Advances in PC hardware have also helped boost performance. Today's 386-based computers have so much processing power and access to so much memory that they make up for DOS's lack of optimization for server operations. The advantage of a very efficient disk operating system, such as the one underlying *NetWare*, becomes less important when the computer has processing power to spare and lots of memory for disk caching.

These products have also improved because of advances in the architecture of this kind of software. The packages use code written in a combination of C and assembler so that programmers can create features with powerful C libraries, frequently update the software, and still maintain fast throughput. Writing fast code for DOS redirectors is an arcane art and the best programmers know undocumented DOS calls and a variety of techniques for improving performance and keeping the programs small.

Finally, DOS LANs can challenge their higher-priced competitors like *NetWare*, *LAN Manager*, and *VINES* because of changes in DOS itself. We ran these products over a prerelease version of Microsoft's DOS 5.0 to check for compatibility, because it will be the operating system of choice for anyone installing LANs running over DOS. Version 5.0 introduces memory-management features and includes the ability, introduced in DOS 4.0, to use disk-drive volumes as large as two gigabytes. Together, these features provide the RAM and disk space needed to make DOS 5.0 very appealing to anyone setting up a network.

DEFINING TERMS

Advances in technology continue to change and shape how we categorize

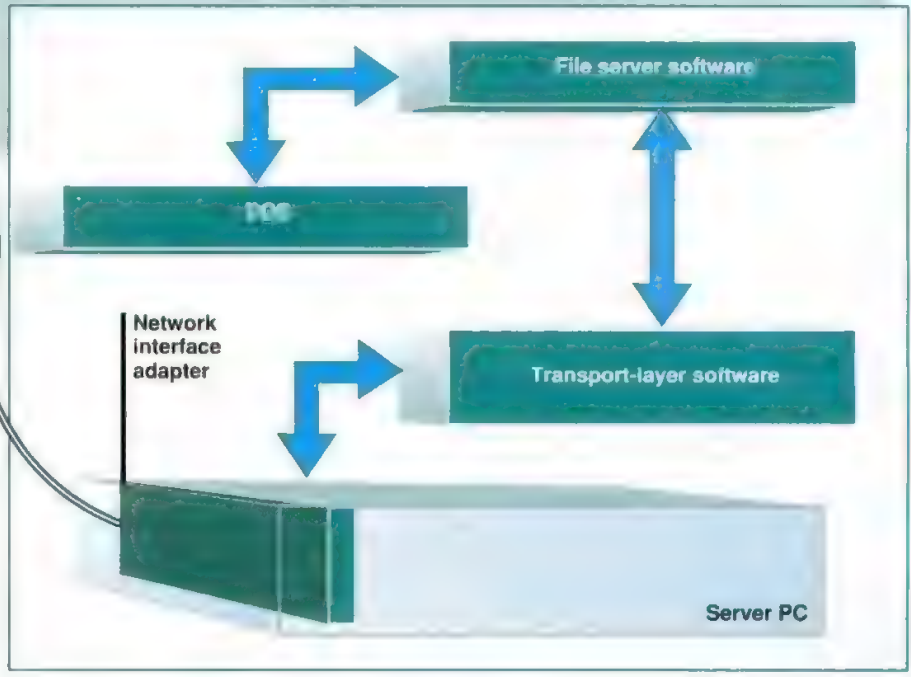
THE SOFTWARE SIDE

Every workstation must have several important program modules. Working together, these modules perform the basic actions of network software: recognizing users, associating their preprogrammed privileges with their identities, and then rerouting their DOS requests to the appropriate server for action.

The operating system in a **client PC** takes requests from **applications** and translates them into actions performed by the video display, disk drives, and other peripheral devices. DOS-based network software uses a layer of software in each client PC called the **redirector**, which intercepts requests for services from application programs and routes them to the **transport-layer software**, either NetBIOS or IPX.

This software moves the requests to the **network interface adapter**. The adapter takes the data across the **network cabling** to the PC acting as a server. Inside the **server PC**, the **network interface adapter** and the **transport-layer software** move requests for service to the **file server software**, which holds tables of user names and privileges. It passes the calls to the server PC's DOS, retrieves the requested data, and routes it back to the client PC.

The peer-to-peer resource sharing of most DOS-based networks is both a capability and a limitation. It allows great flexibility and makes these networks economical in installations with as few as two PCs. Since these operating systems can run on any Intel processor in the PC family, even IBM PC XTs or Model 30s can share their resources with other PCs. But peer-to-peer resource sharing typically slows response times, stifles the growth of the network, and makes the network more difficult to manage. When files and printers are spread among many servers, administrative problems multiply. ■



products in this field. Three years ago there were two fundamental architectures for network software and therefore, two neat categories of products. One architecture, the client/server model, required the dedication of a computer on the network to the role of file server. The other architecture, peer-to-peer networking, allowed every PC in the network to act as both a client workstation and a file/print server. (Other important terms, particular not only to DOS LANs but also to other network operating systems, are discussed in the sidebar "Touring the LAN," which also provides a look at the fundamental elements of networks.)

Network product classifications were simple then because the client/server, or dedicated server, products used a unique operating system, like Novell's *NetWare*, and the peer-to-peer systems used DOS. Then Novell gave *NetWare* the capability to use a PC as both a server and as a client station, and Microsoft introduced *LAN Manager*, a network product with peer-to-peer capabilities running over the multitasking OS/2 operating system.

Today the only product classification that makes sense distinguishes between those using DOS and those using any other operating system. The "any other" class encompasses dozens of flavors of Unix, hidden versions of Unix like those in *NetWare* and *VINES*, OS/2, and other one-of-a-kind operating systems such as Digital's VMS.

REVIEW CRITERIA

The products reviewed run over industry-standard LAN adapters and use DOS in the PCs that act as servers. We define industry-standard adapters as those using IEEE 802.3 10-megabit-per-second Ethernet, IEEE 802.5 Token-Ring, and ARCnet. Several companies we reviewed—Artisoft, Digital Communications Associates, and US Sage—also market proprietary adapters that use unique media-access control, signaling, and connector architectures as lower-cost alternatives to their faster and more widely supported industry-standard boards.

We don't recommend using LAN adapters that don't follow the latest standards, even though they may cost only two-thirds the price of those that meet the standards. The reason: You could wind up with a network of orphan adapters. Should the company go out of business or stop supporting those nonstandard adapters, you'll have no options for expansion other than throwing them away and starting over. Adapters that meet the industry stan-

dards are reasonably priced, widely supported, and provide top-notch performance. Moses Computers (see the sidebar "ChosenLAN: A Nonstandard Alternative") is one company that insists on marketing strong software on top of proprietary network adapters.

The products in this review all meet a price cap of $375 per user—including software and industry-standard hardware—for a ten-user system. The products are Exzel's *EasyNetwork*, Grapevine LAN Products' *GV LAN OS*, Invisible Software's *Invisible Ethernet NET/30*, D-Link Systems' *LANsmart*, Accton Technology's *LanSoft*, Artisoft's *LANtastic*, US Sage's *MainLan Ethernet*, Performance Technology's *POWERlan*, Compex's *ReadyLink*, Net-Source's *SilverNet-OS*, Solid Technologies' *Solid LAN*, Digital Communications Associates' *10NET Plus*, and WebCorp's *WEB Network Operating System*.

Novell's Entry Level System products, *ELS I* and *ELS II*, have been a mainstay of the small-group network market. But compared to modern versions of *NetWare* and the DOS-based LAN operating systems in this review, the *ELS NetWare* packages are difficult to install and provide no room for growth. If you need to expand the network beyond the eight users provided by *ELS II*, you must throw away the *ELS* software and jump to *NetWare 286*. The new edition of *NetWare*, Version 2.2 (just released at press time), provides a smooth, unbroken path for expansion, reasonable price points, and easy installation. A five-user version of *NetWare* 2.2 costs $895; the ten-user version sells for $1,995. If you use an average street price of $200 for each high-quality Ethernet LAN adapter, the combined retail price of *NetWare* 2.2 in a ten-user installation is $399 per user. That is $50 to $100 more per user than most of the products in this review, but not a bad price for a market-leading manufacturer.

CBIS, Corvus, and Sitka (formerly TOPS) were either revising their products or had not released them in time for this review. Hayes's *LANstep* is another interesting network operating system that was not available in time for our review. Hayes acquired the *Waterloo Port* operating system and derived *LANstep* from it. Hayes states that it has improved the throughput and ease of installation of the product, creating a competitive LAN operating system with true multitasking operation.

FEATURES TO SPARE

Among the DOS-based LAN products' features are electronic mail, across-the-LAN chatting, and management utilities. *LANtastic* comes with its own good e-mail package, but Digital Communications Associates (or DCA), D-Link, and Performance Technology bundle well-known workgroup productivity programs with their LAN software. DCA provides a six-user version of *The Network Courier*, Performance Technology offers an eight-user version of the popular *cc:Mail*, and D-Link provides a three-user version of *Right Hand Man* that includes schedule software, e-mail, a telephone directory, and many other functions.

A top DOS LAN delivers a 100K file in half the time of a standalone PC AT's hard disk.

The Artisoft, DCA, Invisible Software, and Performance Technology products include the ability to run unattended programs on another PC. You can submit a time-consuming job, such as an automated backup of unarchived subdirectories and files, as a task to be carried out on another networked PC. Artisoft, DCA, and Performance Technology also provide excellent utilities to monitor server operation.

All of the products we reviewed will run in the *Microsoft Windows* 3.0 environment, although *10NET Plus* is the only one to ship a true *Windows* application at press time. Invisible Software wrote a special device driver to improve its integration with *Windows*, and Artisoft and US Sage plan to have *Windows* versions available by the time you read this.

PERFORMANCE ISSUES

In general, the operating systems reviewed here perform well enough to meet a range of computing needs. Under a heavy network load equaling the activities of 100 typical workstations, a file server running under top DOS-based LAN operating systems like *10NET Plus*, *LANtastic*, *Invisible Ethernet NET/30*, *POWERlan*, and *WEB Network Operating System* can deliver a 100K file to a client PC in about half a second. This is approximately half the time taken by a standalone PC AT's hard disk. Under a lighter network load, file caching typically allows you to get better file retrieval times from networked drives than from the hard disks found in most desktop PCs.

Network operating systems consume RAM in both the client PCs and servers. Most of the modern programs have slimmed down their resident software by using overlays and putting the redirector and driver elements into memory above the 640K block of RAM used by DOS. In the mid-1980s, the client-PC redirector software used more than 100K, but client nodes now need only 50K to 70K. Additionally, DOS 5.0 introduced the ability to load network software, TSRs, and device drivers into memory above 640K, leaving users with about 620K of available conventional memory. Companies like Helix Software also help save memory by providing utilities such as *NetRoom* that offer similar capabilities. (*NetRoom* allows you to place drivers in extended memory.)

Artisoft, DCA, Invisible Software, Performance Technology, and others provide ways to improve the performance of a PC acting as a server by reducing the memory and CPU power provided to application programs. Their manuals cover this server tuning, which consists of adjusting the cache or time slicing between foreground applications and server operation. (For other ways to optimize performance, see the sidebar "Getting the Most from Your DOS-Based LAN.")

DISK CACHING

Disk caching, the process of using RAM in the server to cache the most recent and frequently requested blocks of data from server storage, greatly enhances retrieval times. Hard disks can retrieve data in times measured in hundredths of a second. Solid-state RAM can deliver the same data in thousandths of a second. With modern computers handling thousands of requests each second, DOS-based LAN clients perceive the difference a disk cache makes in delivering data.

Application programs typically request data in blocks of less than 1K. Caching file systems will typically pick up at least 4K of data surrounding the requested bytes and place them in RAM. Caching does

not speed up initial requests for data, but when subsequent requests for related data can employ the cache, they move more quickly than when they use the hard disk.

Network administrators can often tune the caching software to use different sizes of data blocks. In many operations, the cache hit rate—the number of data requests satisfied by the cache—will exceed 80 percent.

File caching can also speed up user writes to network files. The cache can hold incoming write requests in flagged file-cache blocks; these blocks are systematically written to disk between other user requests. A write-cache has one significant drawback: If the hard disk or server system suffers a catastrophic failure or power outage, the data waiting to be written is lost. For this reason, it's a good idea to make sure that the PC acting as a server is protected by a UPS. Products like *EasyNetwork*, *LANsmart*, *LANtastic*, and *WEB Network Operating System* recognize the signals received from a UPS connected to an RS-232 port and can initiate an orderly shutdown of the system if circumstances require.

With a few exceptions, the companies bundle disk-caching software in the network operating systems. DOS, Versions 4.0 and later, includes a disk-caching program, but those provided with a DOS LAN product typically work better.

SECURITY

A LAN software package typically uses one or more of three types of file security. All the security architectures typically permit a network administrator to allow or deny individuals or groups of users the ability to read, write, create, delete, search, or modify files.

The first plan gives each shared resource on the network a "network name"; a single name can designate an entire shared drive, a subdirectory, or even a file. You can associate a password with a network name and limit the read/write/create capabilities affiliated with that password. Networks based on the old Microsoft MS-NET model use this scheme. The network name architecture makes it easy to protect the shared resources, but one user might have to keep track of several passwords. Security is easily compromised when password management is a headache.

The second security plan assigns specific rights to a specific user and provides a password for the identification of the user. This scheme works fine in small organizations, but customizing the rights of each user quickly becomes an administrative problem in larger networks.

The third security architecture uses the concept of groups: Each person belongs to one or more groups and each group has

EDITORS' CHOICE

- **LANtastic**
- **POWERlan**

DOS-based LANs have matured in many respects since we last reviewed them a year and a half ago. These products are no longer limited to serving networks of two to ten PCs. The best of the bunch can now handle networks of dozens of PCs, thanks to improvements in hardware, DOS, and of course, the programs' code. While the multithreaded architecture of Novell's *Netware*, Version 2.15, lets it retain its speed advantage over DOS-based LANs, the best of the products we reviewed provide competition. Offering simple installation and ease of use, DOS-based LANs also benefit from being priced well within the range of most users' budgets—none of the products we reviewed cost more than $375 per user for a ten-user network.

Two products stand out because of their excellent designs, exemplary user interfaces, and well-rounded features: Artisoft's *LANtastic* and Performance Technology's *POWERlan*. Both companies price their products competitively. Artisoft's two-user starter kit (including two Ethernet cards and software for 300 users) costs $699. A version of the *POWERlan* software that supports unlimited users as well as unlimited dedicated and non-dedicated servers sells for $3,195; with a limitation of five users per dedicated server, the price drops down to $795.

LANtastic has built up a loyal following over the years, and with good cause. Version 4.0 adds to the product's appeal with good throughput, excellent printing capabilities, and with optional hardware, even voice-mail functions. Artisoft further enhances the product with well-implemented security, a LAN diagnostic utility, a disk cache, built-in CD ROM support, and adapters that clone the operation of the Novell NE-1000 and NE-2000 adapters. Small, fast, and reliable, the program is a good bet for any user who doesn't need to network diverse operating platforms.

If you do need to link DOS, OS/2, Unix, and other platforms in an interoperable network, you'll want a DOS-based LAN that implements the SMB (server message block) protocol. The SMB protocol is a shorthand approach to passing requests and data between client PCs and servers that facilitates interoperability among networks with different operating systems. (Not all SMB implementations are standard or guaranteed to be interoperable, however.)

For those users, *POWERlan* is the product to choose. *POWERlan* has many of the same advantages of *LANtastic*, including CD-ROM support, a built-in disk cache, and good security, plus a better e-mail system (albeit without voice capabilities), and excellent implementations of SMB and NetBIOS. On top of that, it was the fastest DOS-based LAN we tested. *POWERlan* doesn't have the loyal, highly deserved following of *LANtastic*, but it is an excellent choice for any user, particularly those who want to do more than network DOS-based PCs.

specific access rights. This architecture, popularized by *NetWare*, makes each person responsible only for his or her password and lets the LAN administrator easily move people into different groups as they change jobs and responsibilities or leave the organization.

DOS-based networks often have poor physical security for the server. If you can get at the server's keyboard, you can access files on its hard disk. If security is a problem, you need to provide physical protection for any PC acting as a file server. That could mean removing the keyboard or locking the machine in a room. Of course, both options mean that you then won't be able to use the machine as a workstation. Some products, including *LanSoft* and *LANtastic*, provide a better option by letting you lock the keyboard on unattended servers.

PRINT SERVER FUNCTIONS

Computers acting as print servers make printers—in some cases as many as five on each print server—available for shared use. Print servers store incoming jobs in a print spool while the jobs wait in a queue for the first available printer, or a specially designated one.

In most DOS-based LANs, any PC can act as a print server. The biggest advantage to a network with several separate print servers is its ability to arrange the location of the printers to suit the users.

The idea of using a PC as a print server and a personal workstation simultaneously has practical limitations. Simply stated, you can slice a PC only so many ways until the people at client stations and the person using the machine for local applications all receive slow service. Hardware interrupts generated by parallel and serial port activity and concurrent requests for access to the hard disk can slow down even the fastest PCs when they operate as both a server and a personal workstation. You must carefully balance the number of print jobs and the type of applications people try to submit and run on the PC chosen for this dual role.

KEEPING COMPATIBLE

All companies participating in this review chose to provide thin Ethernet LAN adapters. Most products we reviewed use adapters compatible with *NetWare* because, in addition to the drivers the companies provide for their own LAN operating systems, they also offer their own drivers for *NetWare*. Any adapters that have a good implementation of NetBIOS are useful under several different LAN operating systems.

Artisoft and D-Link sell adapters that emulate the popular Novell NE-2000 and provide a measure of flexibility. The ability to look like an NE-2000 allows any of the numerous software drivers produced for the Novell adapters by different companies to work with the Artisoft and D-Link adapters. If you later decide that you don't like the software produced by Artisoft and D-Link, the adapters will retain their usefulness in practically any network environment, particularly one running *NetWare*.

The software of almost all products we reviewed, with the notable exceptions of *GV LAN OS*, *Invisible Ethernet NET/30*, *LANsmart*, and *Solid LAN*, will work over a wide variety of adapters with an implementation of NetBIOS that conforms to the general standards. In the cases of those four products, *Invisible Ethernet*,

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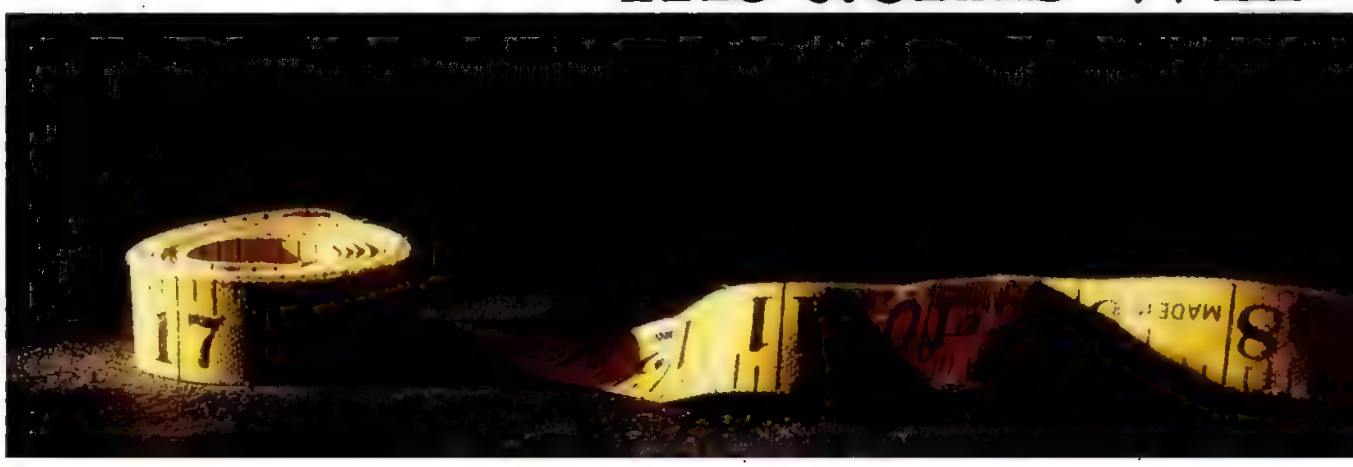
The Pocket Edition is incredibly compact, yet it contains many of the features you expect from our "full-size" Hayes modems. It's ideal for working remotely with your

Once again, Hayes has set modems will



LANsmart, and *Solid LAN* are tied to adapters sold by their manufacturers, while *GV LAN OS* works with adapters that use SEEQ Technology's 8005 chip set.

DCA's *10NET Plus* runs over adapters with the NDIS interface developed by Microsoft and IBM and used in *LAN Manager*. WebCorp takes an interesting approach by following in the giant footprints of *NetWare*. *WEB Network Operating System* runs over any adapters that use the *NetWare* IPX interface. In practical terms, all of the products except *GV LAN OS*, *Invisible Ethernet*, *LANsmart*, and *Solid LAN* will run on hundreds of different ARCnet, Ethernet, and Token-Ring network adapters sold by dozens of different companies.

THE BIG CHALLENGE

There are several changes taking place in the LAN market. Novell has teamed with IBM and raised the price of certain versions of its software for large installations. On the other hand, many DOS-based LAN products—particularly those from Artisoft, DCA, and Performance Technology—now offer the performance and features to carry the network traffic of the largest organizations, and at a lower price. Today's powerful PCs, software, and disk operating systems work in favor of DOS-based LANs, allowing them to challenge old concepts and established competitors.

EasyNetwork

by Sara Parker

EasyNetwork, Version 1.96, from Exzel Corp. is a local area network true to its name. It's easy to install, easy to operate (particularly if you know DOS commands), easy on your RAM, and easy on your pocketbook. Aimed at small businesses and workgroups in large corporations, *EasyNetwork* provides a simple, no-frills way for PCs to share printers connected to the server and to access the server's virtual drives. *EasyNetwork* is not menu-driven; you work with a DOS command line.

EasyNetwork gets you started with a kit, selling for $599, that includes two 8-bit Ethernet cards (for one server and one workstation), software for 30 users, a 20-foot coaxial cable, connectors, and terminators. If you want to add additional nodes to the setup, the cost is $199 per node, which includes an Ethernet card and cable.

FACT FILE

***EasyNetwork*, Version 1.96**
Exzel Corp.,
7585 E
Redfield Rd.,
#107,
Scottsdale, AZ 85260; 602-951-8503.
List Price: Ethernet starter kit, with one Ethernet server card, one Ethernet workstation card, software for 30 users, 20-foot coaxial cable, connectors, terminators, $599. Additional Ethernet cards and cables, $199 per user.
Requires: 13K RAM in client PC, 50K RAM in nondedicated server, DOS 3.3 or later, appropriate ARCnet or Ethernet adapter.
In Short: The most basic of LAN packages, *EasyNetwork* is a relatively inexpensive choice for those familiar with DOS who need only to share the server's hard disk and the attached printers. Limited to a single server, it requires that all stations run the same version of DOS. Its interface is strictly command line, and its performance is not top-tier.

CIRCLE 545 ON READER SERVICE CARD

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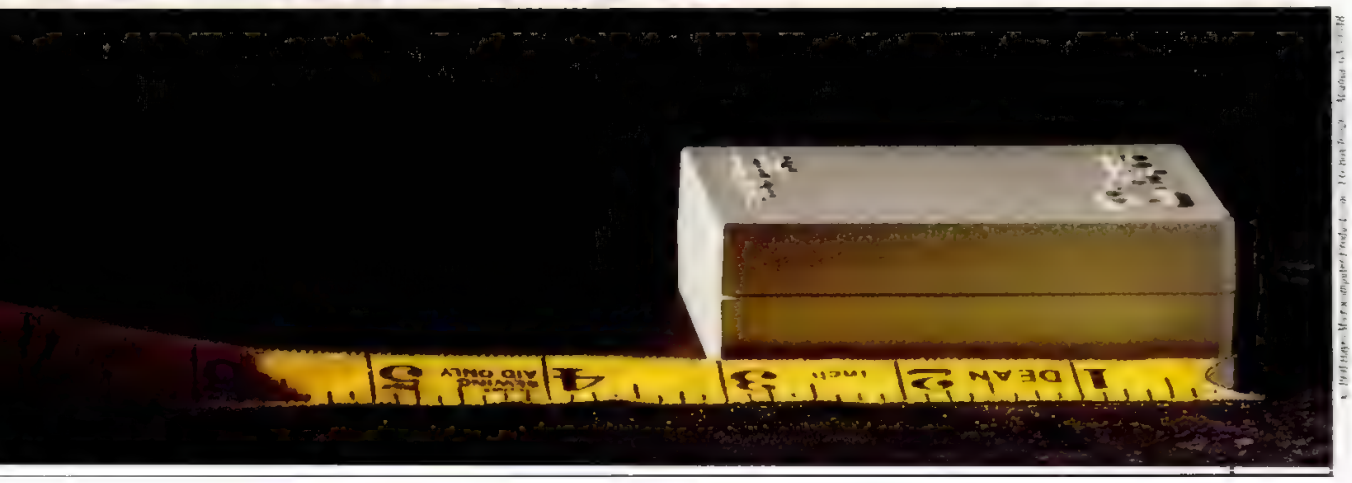

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The LaserJet IIISi is specifically designed for shared-use environments. Its high-volume paper handling features include two 500-sheet input trays and a monthly duty cycle of 50,000 pages. HP offers software-selectable language switching between PCL5 and optional Adobe® PostScript.™ For added versatility, your options include

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The price of the new LaserJet IIISi, just $5,495,* is as impressive as the work load it handles. If you're ready to pick up the pace, call **1-800-752-0900, Ext. 2067** for more information on the fastest LaserJet printer and the name of your nearest authorized HP dealer.

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***EasyNetwork* performed better when using the disk cache provided with DOS.**

This brings the ten-node price to $219 per node. EtherNIC manufactures the adapters, while Sage makes the Ethernet controller chips. The adapters are interoperable with *NetWare*-compatible operating systems. Exzel says it hasn't tested its software to see if *EasyNetwork* will run on any other adapters.

SINGLE SERVER ONLY

Before you install *EasyNetwork*, you must decide which PC you will pick as your server and which ones you will designate as your workstations. (The Ethernet card designated as the server differs from the workstations' cards.) The server must contain a hard disk. If you plan to share printers, a RAM disk, or a CD-ROM drive, they are limited to the server.

EasyNetwork's installation is simple. The software does not insist on knowing the Ethernet address or serial numbers of the adapters. The package automatically revises your CONFIG.SYS but makes a copy of the original file.

You have full use of your server when using *EasyNetwork*, since it always acts as a nondedicated server. You must run the TSR Host-On each time you reboot the server; you can include it in an AUTOEXEC.BAT file. While testing *EasyNetwork*, we found that the file server used 50K RAM and the client station used 13K. There is no memory manager built into the operating system, but with third-party software, you can load the server TSR into extended memory in order to save RAM.

DOS DOES THE TRICK

You won't find a built-in disk cache in *EasyNetwork*, but like other operating systems we tested, it performed better when using the disk cache provided with DOS. E-mail is another feature that *EasyNetwork* currently doesn't supply.

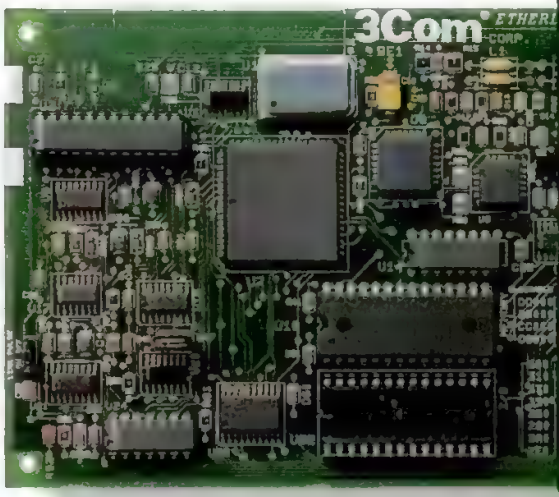
You can use *EasyNetwork* to print locally, with the PRINTER L command, or through the server with the PRINTER R command.

EasyNetwork has a few quirks. The company warns that you must run identical versions of DOS on the server and all workstations for the network to operate properly. You also cannot support more than one server per cable.

EasyNetwork's concise documentation runs only 12 pages. For technical assistance, you can call the company on weekdays from 8:00 A.M. to 5:00 P.M., M.S.T. The support is free; the user pays for the call.

EasyNetwork doesn't do anything wrong; it just doesn't do as much as other products we reviewed. While its performance on our benchmark tests did not rank at the very bottom, it wasn't far away. If you want a LAN with bells and whistles, keep shopping. But if all you need is an inexpensive solution to host file and printer sharing, and you are willing to live with its limitations, *EasyNetwork* may be worth a look.

Oh, what a twis



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GV LAN OS

by Sara Parker

Grapevine LAN Products targets small businesses and corporate workgroups with its *GV LAN OS* software. Since our last review of DOS-based LANs (see "Making Do with DOS," *PC Magazine*, May 29, 1990), Grapevine has made some changes to its product. Still simple to install and use, Version 1.4 now includes support for CD-ROM drives and *Microsoft Windows* 3.0. Grapevine has also improved the system's reliability.

The *GV LAN OS* software is reasonably priced at $395 for three nodes, $695 for seven nodes, and $1,095 for an unlimited-node version. Grapevine's operating system supports only those Ethernet cards that use SEEQ Technology's 8005 chip set. (The product also supports ARCnet adapters.) Current manufacturers include Kodiak Technology and Everex Systems, so we couldn't test the software with Novell NE-2000 or Western Digital cards. Grapevine can provide the $155 Kodiak Raven 8-bit card with its system, and at press time, was negotiating with Everex Systems to bundle Everex's adapters.

We used Everex's SpeedLink/PC16 Ethernet adapters to test *GV LAN OS*. They list for $329 per card, but the price drops to $149 per card if you purchase ten or more. (Everex also manufactures an 8-bit Ethernet card for $229 per node.) Since you pay $1,095 for an unlimited-user *GV LAN OS* license, the software for ten nodes costs about $110 per node. This gives the product a price of $259 per node for a ten-node network with Everex 16-bit cards installed. With Kodiak 8-bit cards, the cost comes to $265 per node.

SELF-CONFIGURING OPERATION

Installation of the operating system is a breeze. You can follow the standard installation procedure or save time by using the quick-install method; both are fast and concise. *GV LAN OS* automatically configures itself to the interrupt-channel number and I/O address of the Ethernet card and dynamically fine-tunes your defaults. Revising the CONFIG.SYS during installation, you can configure your PCs as workstations, or as dedicated or nondedicated file servers or print servers.

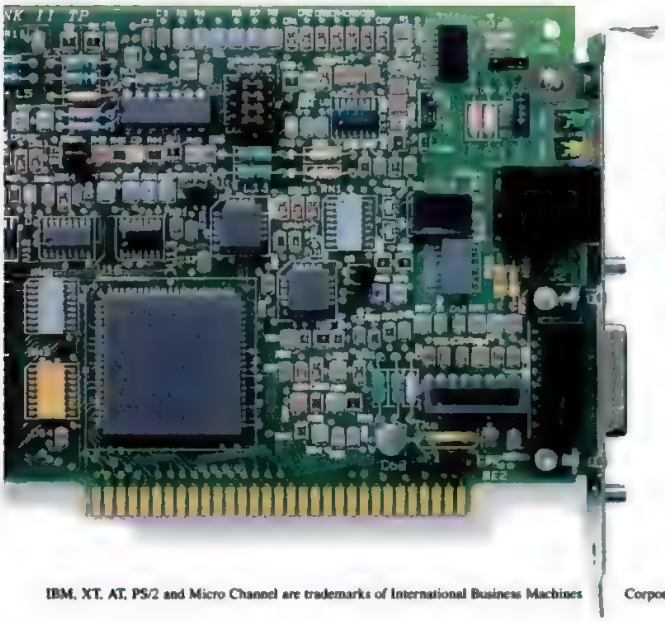
FACT FILE

***GV LAN OS*, Version 1.4**
Grapevine LAN Products Inc., 8519 154th Avenue NE, Redmond, WA 98052; 206-869-2707.
List Price: Three-user version, $395; seven-user version, $695; unlimited users, $1,095
Requires: 85K RAM in both client PC and nondedicated server for nonmenu mode, 129K RAM in both client PC and nondedicated server for menu mode, DOS 3.1 or later, appropriate ARCnet or Ethernet adapter
In Short: A reliable, easy-to-use operating system, *GV LAN OS* accomplishes peer-to-peer networking while attending to the administrative chore of fine-tuning system defaults. Its performance declines as the network load increases, so you'll want separate file and print servers. It supports only a limited number of Ethernet cards, but certainly remains an affordable solution.

CIRCLE 546 ON READER SERVICE CARD

During our testing, we found that *GV LAN OS* uses a rather high 85K RAM in both the file server and client PC, with 129K RAM in either system necessary in menu mode. To reduce the amount of

ted life it leads.



Of course, EtherLink 10BASE-T adapters are compatible with your hardware. And you can use them with virtually all software on your network. For IBM PC, XT, or AT there's EtherLink II® TP. For Micro Channel PS/2 models there's EtherLink/MC TP.

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CIRCLE 293 ON READER SERVICE CARD

RAM needed by as much as 60K, you can load both the server and workstation software into expanded memory.

Grapevine has not included support for remote-boot ROM or disk caching, although third-party disk caches work fine. You can also use third-party memory managers.

In a no-load situation, the Grapevine system performed reasonably well. But as the network load increased, performance declined quickly. We were unable to complete our printer test; under the load of heavy file activity the software reported "printer hung" and stopped all printing. You'll certainly want to establish separate print and file servers for *GV LAN OS* for handling any reasonable network load.

MENU-DRIVEN UTILITIES

If you're not running *GV LAN OS* from the DOS command line, you can access its pull-down menus through a pop-up TSR invoked by your choice of hotkeys. The menus are easy to use and self-explanatory, with options for selecting devices and print queues, defining drives, sending and receiving mail, and controlling the network.

You can easily access the package's e-mail utility from the menu and choose a variety of options, such as creating your own e-mail note, forwarding messages you have received to other network users, and saving messages to a file. You can also designate a PC as a post office to store messages for any users who have temporarily left the network. The waiting mail is automatically forwarded to its proper recipient as soon as the person logs back on. *GV LAN OS* does not include a chat feature.

Security features, which rate as fair, are also accessible through the menu system. Users can make selected drives, directories, and files available for public network use with password protection. Access levels include read only, write, and permission to create new files. You can combine different levels of access.

GV LAN OS's printing capabilities are equally easy to use. Through the pull-down menus, your options include canceling print jobs from the queue, temporarily holding your print job, moving the

CHOSENLAN: A Nonstandard Alternative

by Frank J. Derfler, Jr.

The DOS-based LAN products in our review all use adapters that conform to the IEEE 802.3 (Ethernet), IEEE 802.5 (Token-Ring), or ARCnet industry standards. But some LAN adapters sold by companies such as Artisoft, Digital Communications Associates, US Sage, and Moses Computers don't meet any industry standards for their wiring and signaling schemes. These adapters often use a single pair of telephone wires to carry signals between PCs and offer signaling rates of 1 to 4 megabits per second. The packages also carry lower price tags than a few of the products in our review—typically about $250 per node. But many other DOS-based LAN products that include industry-standard adapters are now also available at or below this price.

Because the software from these companies is uniformly good, using the proprietary adapter alternatives merits the consideration of users on a low budget who aren't particularly concerned about future expansion. The problem with using these adapters is that their wiring and signaling schemes are incompatible with each other and all other products on the market. If the company goes out of business or stops supporting its proprietary adapters, your options for expansion and upgrades will be very limited.

All of these companies except Moses Computers now offer IEEE 802.3 standard adapters as faster, more interoperable, and somewhat more expensive alternatives to their proprietary adapters. The main review covers the packages from Artisoft, DCA, and US Sage. *ChosenLAN*, made by Moses Computers, offers no alternative standard adapters and runs only on its own cards, but it is widely accepted in the industry.

ChosenLAN is optimized for small network configurations. The $499 *ChosenLAN* Star starter kit comes with one circuit board that works as a typical single-station network adapter, along with another circuit board that acts as both a network adapter and a wiring hub for up to four other LAN adapters. (Additional adapters are $179 each.) The wiring for the network is simple two-pair telephone wire, unshielded and even untwisted, using standard RJ-11 connectors. The company's literature says that you can use up to 500 feet of wire between nodes, a relatively long distance.

We quickly installed two *ChosenLAN* nodes and found the software easy to use. All nodes can simultaneously act as servers and client PCs, but *ChosenLAN* makes no provision for dedicated servers. A PC configured as both a server and a network client can lose as much as 135K of RAM from the lower 640K to the network software. But since the redirector and server software can take advantage of expanded or extended memory, applications can lose as little as 35K to the network software if a PC comes equipped with either type of memory.

You can't fault *ChosenLAN* for its security or easy-to-use features, but it doesn't offer the operational features of competing products like *LANtastic*. Its lack of conformity with the industry standards is also a drawback, but *ChosenLAN* remains an easy and economical package. ■

***ChosenLAN*, Version 1.12**
Moses Computers Inc., 15466 Los Gatos Blvd., #201, Los Gatos, CA 95032; 408-358-1550; infofax: 800-882-6673.
List Price: Star starter kit, with one hub adapter, one client adapter, five-user version of *ChosenNOS* software, $499; chain starter kit, with two peer-to-peer cards, four-user version of *ChosenNOS*, $455; two-computer system, with two cards and two-user version of *ChosenNOS*, $350. Additional adapters, $179.
Requires: Unshielded, untwisted four-wire RJ-11 connectors; 135K RAM for combined client/server (35K under relocation); 84K RAM for server alone (22K RAM under relocation), 47K RAM for client alone (9K under relocation).

CIRCLE 544 ON READER SERVICE CARD

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Jim Seymour

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For a free brochure and a local dealer, call **800-535-4242** or **415-572-2700**.

CIRCLE 220 ON READER SERVICE CARD

KENSINGTON.

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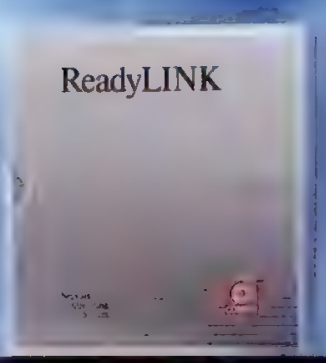
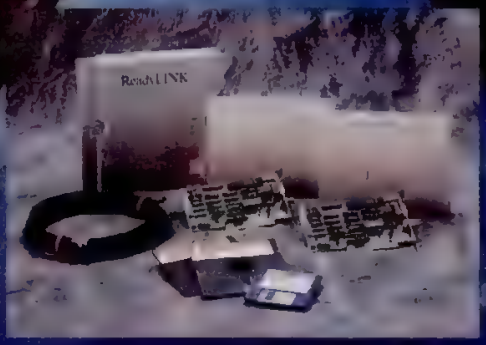
Super Structure



ReadyLINK+ ...



Building a PC network? Build it with ReadyLINK+, the super structured software program by **COMPEX**. ReadyLINK+ is a complete, low-cost network operating system for IBM PCs and compatibles. It uses industry standard interface cards, so you can expand or upgrade to NetWare quickly and easily.

ReadyLINK+ also features menu-based desktop management and task-switching. And installing ReadyLINK+ gives you Lightning – a high performance disk cache routine that speeds throughput to, well, lightning speeds.

Best of all, you can buy ReadyLINK+ at a very low retail cost per network – just $299, with workstation hardware costs as low as $89 per station.

Getting your network operating system from **COMPEX** means joining the more than a quarter of a million **COMPEX** users worldwide. Our complete line of Ethernet and ARCnet products and ReadyLINK+ are always designed with the construction you need for the cost you want.

So, when it's time to build your PC network, build it with ReadyLINK+, the super structured software program without a high rise cost.

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CIRCLE 739 ON READER SERVICE CARD

job to the top of the queue or the end, and restarting a job that stopped midway through. Selecting another queue gives you a list of jobs waiting in the queue. If you need to print a job quickly, you can check the queues of other printers on the network for the one that is shortest.

If you have any difficulty with *GV LAN OS*, you can get free technical support from Grapevine for 30 days from the date of purchase by calling a toll number on weekdays from 8:00 to 5:00 P.S.T. Grapevine also offers unlimited technical support for dealers.

GV LAN OS is a very easy LAN to install and use. It lacks a few built-in features like a disk cache, but third-party disk caches work well, as does DOS's SMARTDRV. If your company is looking for a peer-to-peer LAN that doesn't need a lot of network administration, Grapevine offers an affordable but not lightning-fast solution.

Invisible Ethernet NET/30

by Kimberly Maxwell

Invisible Software gave its old yet dependable *Invisible Ethernet NET/30* a face-lift, making it one of the fastest and friendliest DOS-based LANs on the market. *NET/30*'s proprietary communications protocol, new disk-caching utility, and a variety of built-in memory management modules add up to good performance. The hardware/software package sells for $349 per node.

Each package comes with your choice of 8- or 16-bit Ethernet cards with extra-support T-connectors, and a floppy disk containing software for an unlimited number of users. We used the 16-bit cards in our tests. Invisible Software also sells a 32-bit Micro Channel Ethernet card for $469 and a proprietary 1.8-Mbps twisted-pair card for $250, with software included. The *NET/30* software runs only on the company's hardware.

Invisible Ethernet NET/30, Version 2.0, is very different from the Version 1.52s we tested last year (see "Making Do with DOS," May 29, 1990). It includes a proprietary communications protocol called TransBIOS. TransBIOS increases the speed and efficiency of the LAN by analyzing traffic between client PCs and servers and transparently altering the number of packets as needed. The program also contains the standard NetBIOS protocol. When testing *NET/30* last year, we had to load NetBIOS from a floppy disk.

NET/30 provides a top-notch security system to grant permission to individuals or groups.

Each Ethernet adapter card includes a boot ROM so you can remotely boot a diskless workstation. You can enable and disable the boot ROM through jumper switches. Invisible's Ethernet cards come with drivers for *NetWare 286* and *386*. The cards also work with CBIS's *Network/OS*, IBM's *PC LAN*, or any NetBIOS-compatible software.

HELP ON THE WAY TO INSTALLATION

Diagnostic software built into *NET/30* runs on the server while it checks the other network PCs for collisions, lost sessions, and any errors on the BIOS level. You should run the stress test before setting up the software on the other machines.

Invisible presents two alternatives for installing *NET/30:* an easy method with standard network configuration defaults and an advanced method that allows you to fine-tune the system. Both methods change the CONFIG.SYS and AUTOEXEC.BAT files automatically.

If you want to configure a PC as a dedicated server, you must use the advanced installation option. Otherwise, you can configure it as a nondedicated server or as a client PC. A server station requires 85K of RAM, while a client PC requires 60K of RAM.

NET/30's Invisible RAM utility is a shadow RAM manager that allows you to load DOS applications and your memory-resident programs outside of DOS's main memory. When you begin to use the utility, you may want to check your manual or type WHATMEM to find out the proper memory management arrangement for each machine.

You don't have to perform any special configuration tasks to run *NET/30* under *Microsoft Windows* 3.0; we had no difficulty running it while in *Windows*. While *NET/30* is not a *Windows* application, Invisible Software provides a special redirector to ensure that both environments work well together.

RESOURCE SHARING ON THE MENU

When you begin to share disks, files, peripherals, and even a CD-ROM drive, you can use either the DOS command line or a menu system. Moving through the menu system is much easier than entering a string of commands.

If you want to secure resources or files from specific users, *NET/30* provides a top-notch security system to grant permission to individuals or groups. Password protection is also available. With *NET/30*, you can remotely manage other stations' shared resource configurations. But if end users don't want others to manage their stations, they can configure their machines to prevent it.

If you follow the directions, printing with *NET/30* is an uncomplicated task. *NET/30* was the only product we reviewed that offered software XON/XOFF and hardware DTR flow control features for sending data to serial printers. You can change printer settings at any time, and pause, restart, or clear print queues by tagging them on the menu. Users with full queue privileges see all print jobs, not just their own.

Our testing revealed, however, that

FACT FILE

***Invisible Ethernet NET/30,* Version 2.0**
Invisible Software Inc., 1142 Chess Dr., Foster City, CA 94404; 415-570-5967.
List Price: $349 per user, including 8- or 16-bit Ethernet adapter, software for unlimited users. 32-bit Micro Channel Ethernet card, $469; 1.8-Mbps twisted-pair card, $250.
Requires: 60K RAM in client PC, 85K RAM in nondedicated server, DOS 3.1 or later, appropriate Ethernet or proprietary adapter.
In Short: A powerful DOS-based LAN with high performance, *NET/30*'s special features make it one of the strongest contenders in our roundup. These features include a proprietary communications-optimizing protocol and shadow RAM memory-management utilities. Its biggest flaw is that the network software would not send anything to the printer while it was servicing disk access requests, so if you use it, you should install separate print and file servers. Otherwise, you won't go wrong choosing *NET/30* as your DOS-based network operating system.

CIRCLE 547 ON READER SERVICE CARD

NET/30 actually gives printing a very low priority. We found that the network software, unlike most products we reviewed, would not send anything to the printer as long as it was servicing disk access requests. In some organizations this priority will not matter, but if you expect your *NET/30* network to carry heavy printing and disk access loads, you should install separate print and file servers.

NET/30 includes a disk-caching utility that you can alter for better performance, although the preset defaults showed the best test results. An automatic reconnection utility keeps each PC in the application it was running, in case the network suffers a momentary interruption. Some competing products bounce you out of the application.

A 2K TSR e-mail feature offers a minimal message capability that lets network users exchange simple messages at the top of the screen. A beep alerts you when a message arrives on your PC, but there is no split-screen chat facility.

On-line help and thorough documentation help make operating *NET/30* a breeze. If you need more assistance, you can call Invisible for free technical support on a toll line, weekdays from 9:00 to 6:00 P.S.T.

Fast transfer speeds make *NET/30*'s price of $349 per node the right choice for anyone looking for a powerful yet fundamentally easy-to-operate product. But you must plan on installing separate print and file servers, particularly if you expect *NET/30* to bear heavy printing and file-sharing traffic.

LANsmart

by Kimberly Maxwell

D-Link's *LANsmart* can coexist with other networks while providing much of the functionality of powerful network systems. For small- to medium-size offices seeking a DOS LAN that can attach to Novell's *NetWare*, *LANsmart*, Version 2.1, is a good choice. In a ten-node system, its software and hardware together sell for a very low $222 per node. And with an upgrade package, *LANsmart* can coexist with TCP/IP and access Unix and Xenix servers.

For just $650, D-Link offers a two-node starter kit with two 8-bit Ethernet adapters, system software for unlimited users, coaxial cabling, and reinforced T-connectors. D-Link also bundles with *LANsmart* a three-user version of Futurus's *Right Hand Man*, a workgroup scheduling and e-mail package.

D-Link's 16-bit Ethernet card emulates Novell's NE-2000 adapters and sells for $345. For our tests, we used a D-Link 16-bit adapter in the server and $175 8-bit cards in the client PCs and found that with the 16-bit adapter in the server, performance improved as much as ten percent.

If a **program can be unloaded from server** or **workstation RAM**, you can regain RAM for applications without rebooting.

Quick-install indicates whether the program can prompt the user with questions (such as whether a node should act as a server) and then properly load the files and configure the software for operation.

Separator pages keep print jobs apart for easy distribution once they come off the printer. If the software allows for **customizable separator pages**, you can provide more-complete information for administrative routing.

File server software that **reacts to signals from UPS** can respond in many different ways to a notice that the server is running on battery power. At the least, it will broadcast a notice to users. In some cases, it will also initiate an orderly shutdown sequence in response to signals of low battery power.

Interfaces with IPX/SPX refers to the product's ability to run over Novell's IPX transport layer.

A package that **marks files for execution only** helps security. Once it marks files as executable, they cannot be copied or read—just run.

DOS-BASED LANs: SUMMARY OF FEATURES

Products listed in alphabetical order

	EasyNetwork	GV LAN OS	Invisible Ethernet NET/30	LANsmart
List price	$599	$1,095	$349	$650
Price includes	Starter kit with 2 adapters, 30-user software	Unlimited-user software	One adapter, unlimited-user software	Starter kit with two adapters, unlimited-user software
MEMORY				
RAM used in file server	50K	85K (129K with menus)	85K	80K
RAM used in workstation	13K	85K (129K with menus)	60K	2K
Extended memory	■	❑	❑	■
Expanded memory	■	■	■	■
Built-in memory manager	❑	❑	■	❑
Program can be unloaded from server RAM	■	■	❑	■
Program can be unloaded from workstation RAM	❑	■	❑	■
INTERFACE				
Menu-driven	❑	■	■	■
DOS command line	■	■	■	■
Mouse support	❑	❑	❑	❑
Windows version available	❑	❑	❑	❑
SOFTWARE				
Quick-install	■	■	■	■
Disk cache in server software	❑	❑	■	■
Print queue displayed at client station	❑	■	■	❑
Customizable separator pages	❑	❑	❑	■
Supports CD-ROM devices over network	■	■	■	■
Supports remote-boot ROM	■	❑	■	■
Supports dedicated servers	❑	■	■	❑
Reacts to signals from UPS	■	❑	❑	■
Displays active users	❑	■	■	■
Keeps error log	❑	■	❑	❑
Displays network resources menu	❑	■	■	■
Tracks resource usage	❑	❑	❑	■
Interfaces with IPX/SPX	❑	❑	❑	❑

—Editors' Choice ■—Yes ❑—No

(For comparison's sake, we also ran the tests using an 8-bit adapter in the server; since our tests called for using a 16-bit adapter in the server whenever available, we do not report these contrasting results in the table of benchmark tests.) The Ethernet cards come standard with BNC and AUI connectors, but there are also 10BaseT models with RJ-45 connectors available, including a Micro Channel 10BaseT for $495. The product also works with D-Link's ARCnet cards.

LANsmart provides an array of network drivers, including ones for *DECnet DOS*, FTP PC/TCP, NetBIOS-compatible software, *NetWare 286* and *386*, IBM *PC LAN*, SCO Unix and Xenix, Sun Microsystems' *PC-NFS*, and 3Com's *3+Share*. A special software driver lets *LANsmart* network users map to a *NetWare* server and access a NetBIOS-compatible network server simultaneously. D-Link separately sells *TCP/IP for DOS*, the software needed for *LANsmart* to migrate to Unix, for $400. *NetWare* 2.1*x* or *NetWare 386* users can purchase *LANsmart for Novell* to add its capabilities to their network.

LANsmart did not achieve particularly high throughput on our benchmark tests. The maximum we could get was about 630 kilobits per second, as opposed to over 2.5 megabits per second from several other products. The architecture of *LANsmart* also foiled our printer testing. The software spools everything out to the printer and degrades file server performance to nothing. You certainly should set up separate nondedicated print and file servers when you install a *LANsmart* network.

LANsmart users can map to a NetWare server and access a NetBIOS-compatible one simultaneously.

LanSoft	LANtastic	MainLAN Ethernet	POWERlan	ReadyLink	SilverNet-OS	Solid LAN	10NET Plus	WEB Network Operating System
$599	$699	$525	$3,195	$699	$699	$359	$799	$995
16-user software	Starter kit with two adapters, 300-user software	Starter kit with two adapters, unlimited-user software	Unlimited-user software	Starter kit with two adapters, 255-user software	Starter kit with two adapters, 2-user software	One adapter, unlimited-user software	10-user software	15-user software
57K	47K	55K	32K	133K	41K	60K	70K	64K
38K	25K	30K	14K	80K	31K	20K	29K	64K
○	●	●	●	○	○	●	●	●
○	○	●	●	●	○	●	●	○
○	○	○	○	●	○	●	●	○
●	○	○	●	●	○	○	○	●
●	○	○	●	●	○	○	○	●
●	●	●	●	●	●	●	●	●
●	●	●	●	●	●	●	●	●
○	●	○	●	○	●	●	○	● (DOS 5.0 programs only)
○	○	○	○	○	○	○	●	○
●	●	●	●	●	●	●	●	●
○	●	●	●	●	○	●	●	●
●	●	●	●	●	●	●	●	●
○	●	●	●	●	○	○	●	●
●	●	●	●	●	○	●	●	●
●	●	○	●	○	○	●	○	○
●	●	○	●	●	○	●	●	●
○	●	○	●	○	○	○	○	●
●	●	●	●	●	○	●	●	●
○	●	○	●	○	○	○	●	●
●	●	●	●	●	●	●	●	●
○	●	●	●	○	○	○	●	●
●	○	○	●	●	○	○	○	●

CONTINUES

LANsmart's base operating system offers simple tools that allow users to share drives, peripherals, printers, and CD-ROM devices. You can view and manage print queues and see shared resource information and the names of network users. If you want frills like asynchronous communications, bridge software, remote access, and remote boots, you must purchase these packages separately.

You don't need any additional software to run *LANsmart* under *Microsoft Windows* 3.0 in Enhanced mode. But you should set the parameter WIN:ON at LOGON to avoid conflicts. A Microsoft high-memory driver lets you partially load *LANsmart* into memory above 640K to make coexistence possible.

Before you copy *LANsmart*'s files onto all of the networked hard disks, you must install the D-Link cards and connect the network. *LANsmart* runs only on D-Link's cards, although the cards can support other operating systems. During installation you must answer several configuration questions and identify the network cards' I/O addresses, but you don't have to add any special setup strings to the AUTOEXEC.BAT or CONFIG.SYS; *LANsmart* does this for you.

You can configure each machine as either a nondedicated server or a workstation, but *LANsmart* does not support dedicated servers. Although there is no limit to the number of servers that can be set up, each server requires at least 80K RAM (as opposed to 2K for a workstation). The base operating system automatically uses the expanded or extended memory in your server or workstation but provides no built-in memory manager to load add-on modules into memory above 640K. The disk cache will run in extended or expanded memory.

COMMANDS OR MENUS

You can set up shared hard disks and other resources using *LANsmart*'s memory-resident menu system or the DOS command line. The menu system is simple enough for all to use, while the DOS command-line option requires experience with network administration. If you want to view the shared printer and hard disk resources available, you can see a listing from any workstation.

With passwords controlling read, write, and create rights, you can secure shared resources like files and directories. Although *LANsmart* doesn't maintain an error log, the system alerts you with a documented error message when it runs into difficulty.

Users can exchange messages with all computers on the *LANsmart* network. The screen of the receiving computer displays the message immediately. Users can reply either through menu functions or the command line.

LANsmart's chat program, a 20K memory-resident option, allows you to

FACT FILE

***LANsmart*, Version 2.1**
D-Link Systems Inc., 5 Musick, Irvine, CA 92718; 714-455-1688.
List Price: Two-user starter kit, with two 8-bit Ethernet cards, software for unlimited users, cabling, connectors, $650. 8-bit Ethernet card, $175; 16-bit Ethernet card, $345.
Requires: 2K RAM in client PC, 80K RAM in nondedicated server, DOS 3.1 or later, appropriate ARCnet or Ethernet adapter.
In Short: A friendly menu system makes *LANsmart* a charm to use. Its ability to coexist with *NetWare* and Unix gives it more flexibility than some competitors, but setting up the same machine as a file and print server degrades performance severely. The software is tied to the company's LAN adapters, although you can use the adapters with other operating-system software.

CIRCLE 548 ON READER SERVICE CARD

DOS-BASED LANs: SUMMARY OF FEATURES

Products listed in alphabetical order

	EasyNetwork	GV LAN OS	Invisible Ethernet NET/30	LANsmart
MAIL AND SCHEDULING				
Message feature	❑	■	■	■
Chat feature	❑	❑	❑	■
Workgroup calendar	❑	❑	❑	❑
Stores and forwards e-mail	❑	■	❑	❑
SECURITY				
Access based on user group membership	❑	❑	■	❑
Sets account expiration date	❑	❑	❑	❑
Sets time restrictions	❑	❑	❑	❑
Server keyboard lock	❑	❑	❑	❑
File password protection	❑	■	■	■
Marks files for execution only	❑	■	■	■
Software works with proprietary cards only	❑	❑	■	■
Standard card includes boot PROM	❑	❑	■	❑
ADAPTERS AVAILABLE FROM VENDOR				
ISA:				
Thin Ethernet	■	■	■	■
Ethernet AUI	■	■	■	■
Ethernet 10BaseT	❑	■	■	■
ARCnet coaxial	■	■	❑	■
ARCnet TP	■	■	❑	■
Token-Ring	❑	❑	❑	❑
EISA:				
Thin Ethernet	❑	❑	❑	❑
Ethernet AUI	❑	❑	❑	❑
Ethernet 10BaseT	❑	❑	❑	❑
Token-Ring	❑	❑	❑	❑
MCA:				
Thin Ethernet	❑	❑	■	■
Ethernet AUI	❑	❑	■	■
Ethernet 10BaseT	❑	❑	■	■
Token-Ring	❑	❑	❑	❑
DRIVERS INCLUDED WITH ADAPTERS				
IPX	❑	❑	❑	■
NDIS	❑	❑	❑	■
NetBIOS	❑	■	■	■

PC—Editors' Choice ■—Yes ❑—No

You can find *LanSoft* in English, French, German, Japanese, Korean, and Spanish versions.

chat interactively with up to three other users, employing a screen divided into separate sections for each participant. If you have enough memory available on your PC, you can temporarily leave a chat session to run an application.

LANsmart's documentation and on-line help facility make installation and setup a breeze. If you run into difficulties, D-Link makes free technical support available on a toll line, 8:00 to 6:00 weekdays, P.S.T. The company also provides a bulletin board for users.

LANsmart's simple setup and clear menu system give supervisors and users more time to access their shared resources instead of spending hours configuring and using the package. The words *functional* and *practical* come to mind when using *LANsmart*, but you will have to establish separate file and print servers to get acceptable performance.

LanSoft

by Kimberly Maxwell

If you're looking for a multilingual DOS-based LAN with the ability to connect to *NetWare* and NetBIOS-compatible LANs, as well as Unix TCP/IP servers, Accton Technology's *LanSoft* is your ticket. You can find *LanSoft* in English, French, German, Japanese, Korean, and Spanish versions. Simple to install, it lets users share files and resources easily. *LanSoft*, Version 2.10, didn't perform as well in our benchmark tests as other networks we tested, but the product's features speak for themselves.

Accton sells the *LanSoft* network software separately, charging $299 for a four-user version, $499 for an eight-user ver-

LanSoft	LANtastic	MainLAN Ethernet	POWERlan	ReadyLink	SilverNet-OS	Solid LAN	10NET Plus	WEB Network Operating System
■	■	■	■	■	□	■	■	■
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ENDS

FACT FILE

***LanSoft*, Version 2.10**
Accton Technology Corp., 46750 Fremont Blvd., #104, Fremont, CA 94538; 800-926-9288, 415-226-9800.
List Price: 4-user version, $299; 8-user version, $499; 16-user version, $599; 32-user version, $699; 64-user version, $899. 8-bit Ethernet card, $249; 16-bit Ethernet card, $299.
Requires: 38K RAM in client PC, 57K RAM in nondedicated server, DOS 3.1 or later, appropriate ARCnet, Ethernet, or Token-Ring adapter.
In Short: One of the slowest networks we reviewed, *LanSoft* benefits from being a DOS-based LAN with all the bells and whistles. Easy installation, the ability to connect to *NetWare* and Unix servers, the availability of foreign-language versions, and friendly menus make *LanSoft* a versatile product.

CIRCLE 549 ON READER SERVICE CARD

sion, and $899 for a 64-user version. We used the $599 16-user version, along with enough of Accton's $299 16-bit Ethernet adapters to run our benchmark tests in a one-server, five-workstation environment. For a ten-node network, the *LanSoft* system would cost $359 per node. Accton's 8-bit Ethernet cards sell for $249. You can also use ARCnet or Token-Ring adapters with the software.

Accton's Ethernet card uses surface-mount technology, slimline design, and the company's own Ethernet chip set. Each card comes with a variety of network drivers, including ones for *DECnet*, *NetWare 286* and *386*, FTP TCP/IP, *LAN Manager* NDIS, *LanSoft*, NetBIOS, and 3Com's *3+Share*. With the appropriate network drivers and Accton's MultiConnect program, you can transfer files from a *LanSoft* server to a *NetWare*, TCP/IP, or NetBIOS network server.

Unfortunately, *LanSoft* was one of the slowest networks we tested. Even under ideal conditions, we saw a throughput of only about 570 kilobits per second from a 20-MHz 386 PC. To its credit, the software handled printing well and its performance did not degrade much more, even under the heaviest loads.

Since *LanSoft* does not include a disk cache, we used the DOS SMARTDRV cache utility to enhance network performance during our tests. Network General Corp.'s *Sniffer* detected an irregular pattern in the Ethernet traffic on the network. It was difficult to attribute this to any one cause, but we suspect the server software did not schedule or handle the client requests from the PCs efficiently .

When we ran *LanSoft* under *Microsoft Windows* 3.0, we found it ran in Enhanced mode rather well. The product is compatible with *Windows*, but is not specially designed as a *Windows* application.

FRIENDLY MENU

The product can be run from the command line or its menu system. You can set up a peer-to-peer network with either nondedicated servers or dedicated servers. *LanSoft*'s menu-driven installation makes the process simple and user-friendly. If you choose to set up a full nondedicated file server with print and remote-boot capabilities, it uses 57K RAM. A client PC requires 38K.

To generate a *LanSoft* system, the program automatically creates a subdirectory, copies the *LanSoft* files into it, and changes the AUTOEXEC.BAT file. You need to modify the CONFIG.SYS file yourself to be sure the LASTDRIVE letter value is set appropriately.

Hardware configuration is simple. You don't need to set any DIP switches on the cards you install. *LanSoft* allows you to configure diskless workstations to boot directly from a boot server, as long as the workstations use Accton's network adapter cards with optional remote-boot ROM. The boot ROM and software cost $49 per unit.

HELPFUL UTILITIES

Accton loaded *LanSoft* with utilities. The administrator utility ADMIN allows you to create, change, or delete users, groups, or shared devices and directories, simply by using the list and tag options on its menu system. When you create a shared directory or drive, you can see a directory tree showing the contents of the path you plan to share. *LanSoft* also lets you run ADMIN remotely from a workstation. You can set up passwords to help with network security or create aliases for those devices you want available for certain groups. You can also lock the keyboard to prevent unauthorized people from accessing the file server. If you need help with ADMIN's menu system, you can access an on-line help facility.

ADMIN does not provide the tools to tell *LanSoft* about the connected workstations, printers, and other resources. A separate utility called FSMENU monitors up to 64 workstations and shows activity such as the number of open files. The program makes it simple to spot trouble when something goes wrong.

The printer-server utility lets you create local or shared printers and assign aliases to them. You can manage the print queue from this menu, or change the printer-server configurations. Users can remotely retrieve the printer-server queue from a workstation.

LanSoft ran rather well under _Win_ 3.0 in Enhanced mode, though it's not designed as a _Windows_ application.

Sending messages or files to another network user is a cinch. The sender selects the receiver and types the name of the file. A memory-resident menu then pops up on the receiving user's screen, asking the receiver to accept or reject the file. The software automatically cancels the request after five minutes if the receiver doesn't respond. Also available is a full store-and-forward mail feature that displays a short message when you have mail waiting.

If you need assistance, Accton offers free technical support on weekdays from 7:30 to 5:00, P.S.T., at a toll number.

LanSoft is a full-featured network operating system. It lacks the speed of some other products, but its quick installation and useful utilities do much to offset its slow throughput.

LANtastic

by Sara Parker

Artisoft continues to take a good thing and make it better. *LANtastic*, its peer-to-peer network operating system, has won *PC Magazine*'s Editors' Choice award two years in a row (see "Making Do with DOS," May 29, 1990, and "Low-Cost LANs," March 28, 1989). Its optional

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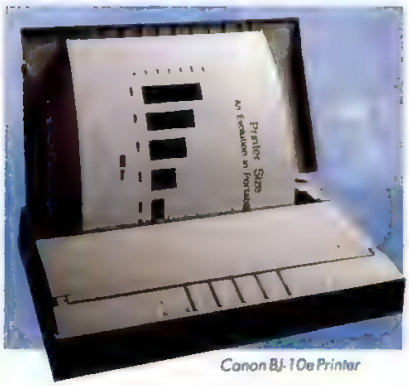

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voice feature, which lets network users chat over data wires using a handset, along with its minimal RAM requirements, high-speed performance, exceptional security features, low price, and reliability, have helped the product gain a large market share. Artisoft has now further improved *LANtastic* by boosting its performance, and will soon release a version that runs as a true *Microsoft Windows* 3.0 application.

Aimed at companies with as few as two or as many as several hundred PCs, *LANtastic*, Version 4.0, proves easy to install, administer, and use. The product requires 25K RAM in the client and 47K in a nondedicated server. A $699 starter kit includes software for up to 300 users, two Ethernet cards, a 25-foot coaxial cable, connectors, and terminators. The DOS version and the upcoming *Windows* version both cost $299 per additional node, and include the network adapter. For a ten-node network, the Artisoft hardware and software cost a combined average of $309 per node.

Artisoft's AE2 Ethernet adapters clone the operation of the Novell NE-1000 8-bit and NE-2000 16-bit adapters, allowing them to run under all drivers for all operating systems designed for Novell adapters. If you later migrate to *NetWare*, you won't have to change hardware. (ARCnet and Token-Ring adapters that have NetBIOS available can also be used.)

FACT FILE
EDITORS' CHOICE

LANtastic, Version 4.0
Artisoft Inc., 575 E. River Road, Tucson, AZ 85704, 602-293-6363

List Price: Ethernet starter kit, with two 16-bit Ethernet cards, software for up to 300 users, 25-foot coaxial cable, connectors, terminators, $699. 16-bit Ethernet card, $299; voice adapter, $99.

Requires: 25K RAM in client PC, 47K RAM in nondedicated server, DOS 3.1 or later, appropriate ARCnet, Ethernet, or Token-Ring adapter.

In Short: *LANtastic* is easy to use and administer, and inexpensive in price and RAM. It also gives dynamite performance. In fact, it can handle 100 users using typical DOS-based applications on a single server. Its optional voice feature and upcoming *Windows* capabilities can add extra dimensions to the network, and the security features are very well-implemented. *LANtastic* is a must-see if you're considering a peer-to-peer network.

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LANtastic's installation process, outlined well by the documentation, is incredibly quick and simple. If you wish, you can change the defaults and fine-tune the system later. You can configure stations as dedicated or nondedicated file or print servers, or as client PCs, and run the software from the command line or via menus. The adapter supports an optional $60 remote-boot flash EPROM for diskless workstations. The EPROM is configured to boot up on either Novell or Artisoft networks.

LANtastic also gives you LANcheck, a LAN diagnostic program that tests network adapters and keeps a log of error, resource, and traffic statistics. We found LANcheck to be a helpful tool for examining and tuning the performance of a *LANtastic* server.

FAST CACHING

LANcache, *LANtastic*'s disk-caching program, is one of the fastest caches we tested. Version 4.0 of *LANtastic* has been improved to cache with expanded, extended, or conventional memory. LANcache also lets you specify the amount of memory you want to cache. (The default is to use all available extended or expanded memory.) With the variable delayed-write function, you can set the interval at which data is actually written to disk. This technique can substantially increase throughput for some applications, although you risk losing data if the server fails.

LANtastic wasn't the fastest network we tested; that honor went to Performance Technology's *POWERlan*. But *LANtastic* certainly carried heavy loads of data and printing tasks that equal those found in networks of many dozens of active users. We do not hesitate to recommend *LANtastic* for organizations with as many as 100 users on a single server—assuming they use typical DOS spreadsheet and word processing applications. *Windows* applications should present no problem, and with a little experimentation you can judge how many users per server your database or CAD applications can support.

LANtastic boasts a good e-mail system, accessible through the menu or through a small, TSR pop-up utility called LANPUP that alerts you whenever you have a message waiting. The unique aspect of the e-mail system is its support for not only a text chat but also a voice chat, if you have the $99 voice adapter. You can store your memos in text or voice files, or forward them to others.

Artisoft's new *Windows* version of *LANtastic* should be available by the time you read this. Its text-chat capability will improve on the DOS version's, allowing you to conduct a running on-screen dialog with another user on the network. Under *Windows*, *LANtastic* will let you see the continuous conversation instead of just line-by-line exchanges.

LANtastic's well-documented installation process is incredibly quick and simple.

LANtastic contains some phenomenal printing capabilities. While one file is printing, the server searches the print queue for files designated for another printer. If *LANtastic* finds a file, the server simultaneously unspools its print queue to two or more printers. This greatly enhances network printing speed, since it permits more files in the queue to print immediately. You can also give higher priority to network users whose print jobs require the fastest execution.

SECURITY TIGHT AS A DRUM

Security in a *LANtastic* network is tight as a drum if you choose. If you are the system administrator, you can set user privileges through an access control list. You can also allocate the day of the week and time of day that specific users get network access.

Some of *LANtastic*'s convenient features can make a system administrator's life much easier. If you have sufficient security privileges, NETRUN allows you to access the server remotely from any workstation. With UPS support now included in *LANtastic*, the automatic server-shutdown option lets you preset a time for the server to turn off. It will notify users immediately before shutdown.

If you have any questions while operating *LANtastic*, simply press F1 to

activate the on-line, context-sensitive help. If you still aren't satisfied, Artisoft offers free, unlimited technical support on a toll line, weekdays from 7:00 to 5:00, M.S.T. The company also provides BBS support and can fax back information that you request.

Reviewing *LANtastic*'s past history makes it no surprise that Version 4.0 is better than ever. With its improved disk-caching abilities and the upcoming *Windows* version, *LANtastic* is faster and easier to use than its successful predecessors, a winner in its own right.

MainLan Ethernet

by Kimberly Maxwell

US Sage no longer markets just its proprietary DOS-based LAN. It now sells a new Ethernet adapter and peer-to-peer network operating system for small- to medium-size businesses. *MainLan Ethernet*, Version 3.22, lets users share programs and files, employ networked printers and plotters, and send and receive messages, using LAN adapters that adhere to the IEEE 802.3 specifications. Best of all is the minimal price of $212 per node for all hardware and software needed in a ten-node system.

A $525 Ethernet starter kit includes two 8-bit Ethernet cards, network operating system software for unlimited users, cabling, high-quality reinforced T-connectors, network drivers, and a bundled disk-cache utility. Additional adapters cost $199 each.

MainLan is easy to use and reliable. The system's throughput placed it in the middle of the pack, but it handled our printing and load tests without fault. The response time is limited by the reliance on 8-bit adapters.

Its LAN adapter is lighter than most, since it uses surface-mount technology and a highly integrated proprietary Ethernet processor and chip set. US Sage continues to market its proprietary 4-megabit-per-second adapters in a $399 starter kit; it also sells the same cards individually.

You can purchase *MainLan* 8-bit Ethernet cards for ISA- or MCA-bus PCs, or IBM PS/1s. Like other DOS-based LANs, *MainLan*'s Ethernet cards come with *NetWare 286* and *386* drivers. If your organization outgrows the *MainLan* software, you can reuse the hardware under *NetWare*. A NetBIOS driver, built into the network software, allows you to run the software over other companies' Ethernet cards if they support NetBIOS.

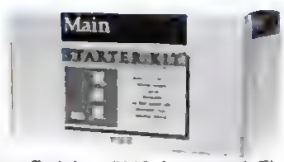
MainLan for Windows should be available by the time you read this. It will let you perform all of the network functions found in the DOS version, but as a true *Microsoft Windows* application that schedules activities with *Windows* and takes full advantage of *Windows*' user-interface features. US Sage plans to sell a two-node starter pack that includes Ethernet adapters. At $625, it will cost $100 more than the standard DOS version. Although the DOS-only version will remain available separately, the *Windows* starter pack will include both the *Windows* and DOS versions.

ONE MINUTE, PLEASE

The DOS version of *MainLan* benefits from a simple 1-minute installation and easy configuration. The package includes clear documentation with detailed information, and a helpful tutorial.

MainLan requires up to 55K RAM on a PC configured as a nondedicated server. You can load several TSR modules into expanded memory or omit them. If you use expanded memory, you can lower the RAM requirement to as little as 16K and still load the basic program modules, including the Menu Handler, Printer Diverter, and Disk Sharer. You cannot configure a PC as a dedicated server.

FACT FILE



***MainLan Ethernet*, Version 3.22**
US Sage Inc., 2005 Tree Fork Ln., #113, Longwood, FL 32750; 800-999-6770, 407-331-4400.
List Price: Ethernet starter kit with two 8-bit Ethernet cards, software for unlimited users, cabling, terminators, $525. 8-bit Ethernet card, $199.
Requires: 32K RAM in client PC, 55K RAM in nondedicated server, DOS 3.1 or above, appropriate Ethernet adapter.
In Short: *MainLan* makes a good move into the mainstream of DOS-based LANs with adapters that meet Ethernet standards. Response time is somewhat limited by the use of 8-bit adapters, but simple installation, nice system features, and a disk cache give the package an edge over some of the more-complicated systems in our review.

CIRCLE 601 ON READER SERVICE CARD

If you use expanded memory, you can lower *MainLan*'s RAM to as little as 16K and still load the basic program modules.

If a client PC doesn't have expanded memory, count on using 32K RAM in the client. *MainLan* lets users load the friendly menu system as a TSR so they can hotkey into it, or load it only when they need to work with the network operating system software and then exit. If you prefer the command line, you can do the same tasks through DOS commands. When we loaded the DOS version of the network and began using *Microsoft Windows* 3.0's Enhanced mode on one of our workstations, we found no problems.

Using the menu system makes it easy to share, erase, and rename files on a remote machine. The NetSetup utility helps protect your directories by granting read, write, and create capabilities. You can even disable other users' access to your entire hard disk. Menus also simplify preventing access to shared resources and sending network e-mail. *MainLan*'s security features are adequate.

CENTRALIZED AND LOCAL E-MAIL

MainLan's e-mail system lets you store your mail on individual computers or in a subdirectory on a central mail server. If you create a mail server, *MainLan* notifies each person of messages received, and they can easily retrieve them with a password. You can update mailboxes, rename or erase user names, and delete old messages.

The print utilities resemble those in other networks. You can divert all printed materials to a named network printer, see all the tasks waiting in the queue, cancel or alter print jobs, or give certain jobs priority. One utility, LocalPRN, improves performance by connecting to a serial printer and automatically determining, via RTS/CTS hardware handshaking, the best speed for communications between the server and the printer.

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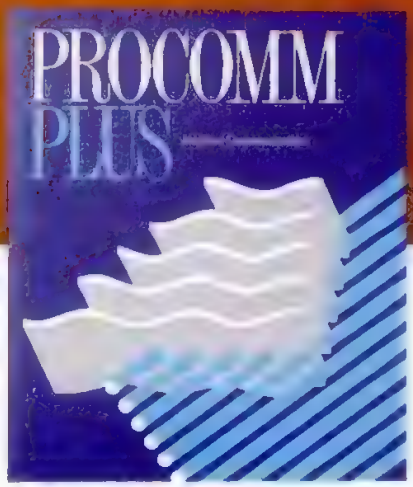

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CIRCLE 504 ON READER SERVICE CARD

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GETTING THE MOST FROM YOUR DOS-BASED LAN

by Frank J. Derfler, Jr.

Installing a DOS-based LAN shouldn't be as complicated as getting a *NetWare 386* network up and running. Still, you can take certain extra steps to optimize the performance of your DOS-based LAN. The following tips can help you get the most out of your network from the start.

■ Plan the balance of dedicated servers, combined workstation/servers, and print servers carefully. The patience of the people using the network, particularly anyone operating a combined workstation/server, should be your guide. When in doubt, plan on using a 386-based computer with a fast hard disk and at least 4 MB of RAM as a dedicated server for 20 "typical" users. If forced to make a choice, spend money on a fast hard disk instead of a fast processor, as long as the processor is at least a 386SX.

■ Buy a UPS for every PC acting as a server. (You should do this even if the LAN software doesn't respond to the signals from a UPS.) At a minimum, file-server software will generally broadcast a notice to users when the server is running on battery power. In some cases, it will wait and initiate a shut-down sequence in response to low battery signals from a UPS. If you use 10BaseT wiring, don't forget to provide a small UPS for the concentrator in the wiring closet. (See "LAN Server UPSs," *PC Magazine*, November 27, 1990, for information on choosing an economical UPS.)

■ If you use thin Ethernet cabling, look closely at each T-connector. The weight of the cables can subject the joint between the barrel of the T-connector and the short leg of the T to great mechanical stress. We've seen several T-connectors with cracks in this joint, resulting in intermittent operational problems. The best T-connectors are marked as meeting the standards of the US Military Specification (MilSpec) UG-274 A/U. They typically contain a reinforcing ring around the joint. As the photo shows, some connectors use the same reinforcement but have not gone through the MilSpec certification process.

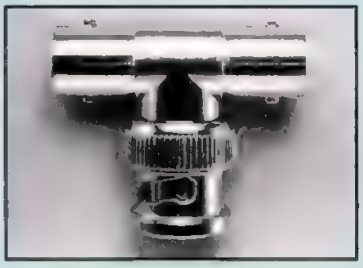
■ Check the manual for instructions on how to adjust the server time slicing. This setting, sometimes called *tasks*, regulates how the server splits its attention between network activity and local applications.

■ Reduce the network load by keeping overlay files on local drives instead of networked drives. Some overlay files, particularly those used by word processing programs, are very large, making it inefficient to draw them through the network. You'll have to customize each program in each PC, but the performance benefits will be worth the trouble.

■ Spend some time tuning the network for the applications people use on it. Experiment with the features of the caching program to optimize performance. Select cached writes only if the PC is protected by a UPS. Also experiment with the BUFFERS= setting in the client PCs. Some networked applications benefit from increasing the buffer settings in the client PC, particularly if they ask for the same data, such as an overlay, repeatedly. Of course, increasing the buffers reduces the available RAM.

■ A hard disk with many fragmented files will slow down the system throughput by 100 kilobits per second or more. Check the hard disk for fragmented files before you install your DOS LAN and again every few weeks thereafter. You can then use standard DOS defragmenting utilities with all of these products. ■

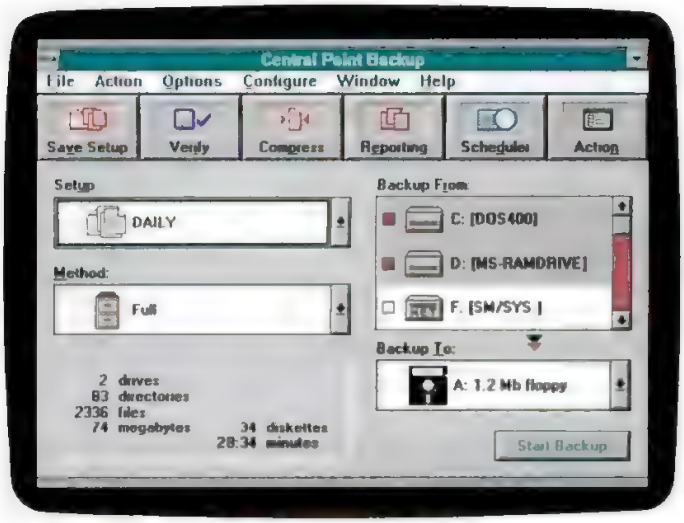
Amphenol Products manufactured the T-connector on the left and marks it on the bottom ring as meeting the standards of MilSpec UG-274 A/U. Unspecified Taiwanese companies make the other two connectors. The connector in the center appears identical to the one meeting MilSpec. The connector on the right includes no reinforcing ring at the junction of the T. Our experience has been that this type of unreinforced connector is subject to mechanical failure.



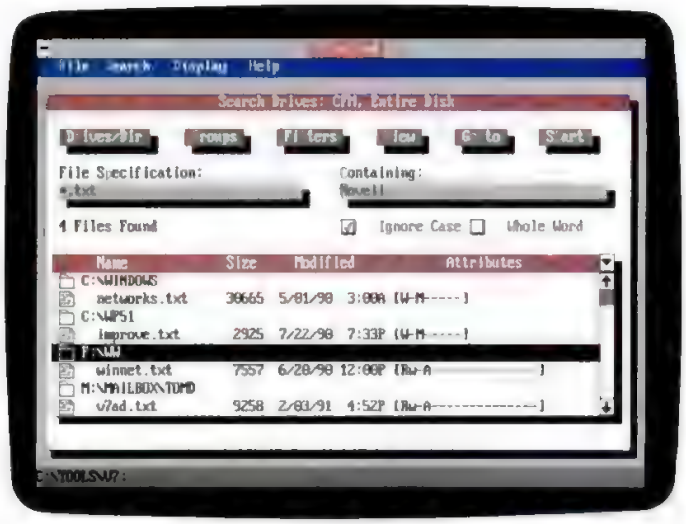
WARNING:

The Following Pages Contain Graphic Material That May Offend Certain Individuals.

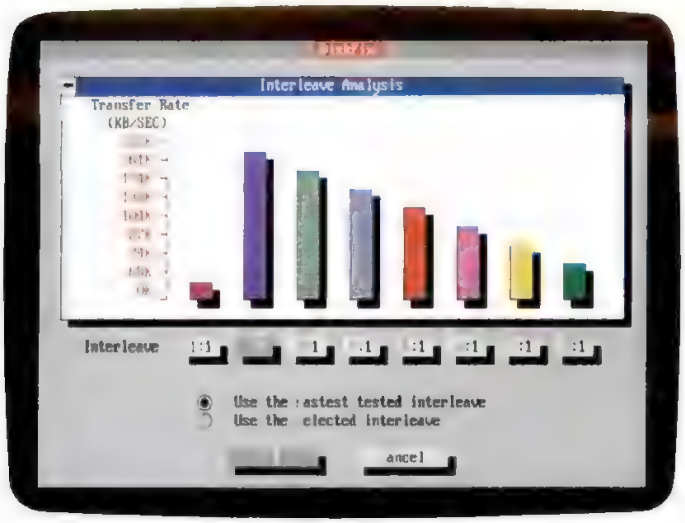
Like The Makers Of Norton, Fastback, XTree, Carbon Copy and Sidekick.



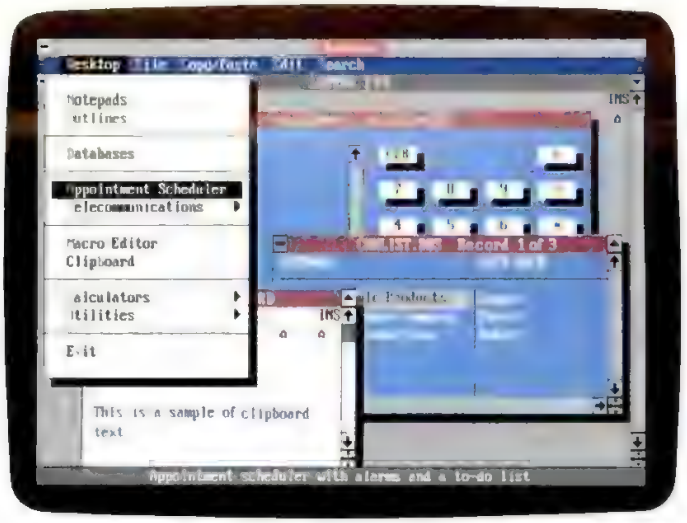
DOS and Windows Backup. Only PC Tools gives you award-winning backup for DOS and Windows in one box. Both programs use the same keystrokes and file formats so you can move to Windows without a hitch.



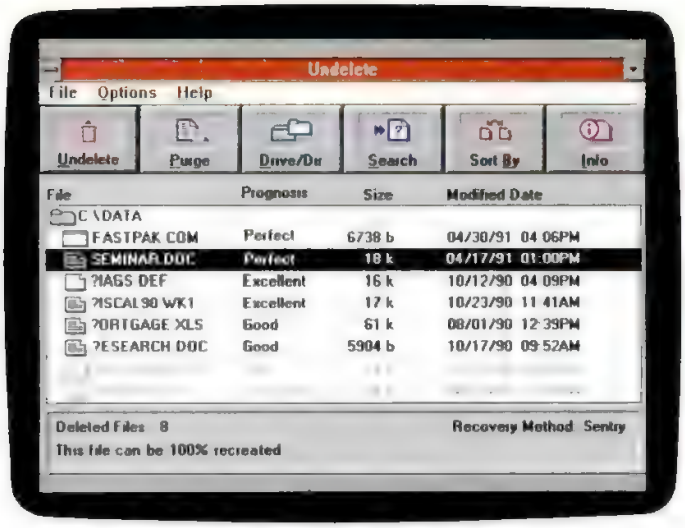
File Find with Viewers. Locate files across multiple drives by name, content or Novell attribute. View data from 37 popular programs. Launch, copy, rename, delete, and change attributes. Operates from the command line.



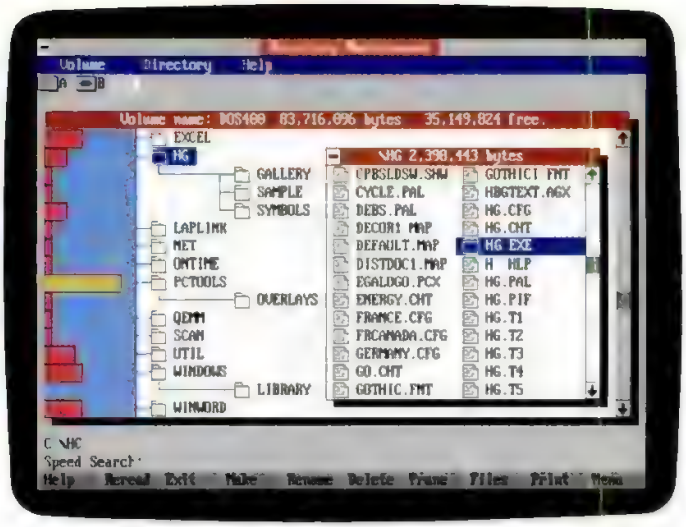
Disk Maintenance and Repair. To help avoid disk crashes and optimize data transfer, our DiskFix™ now does non-destructive, low-level reformatting. DiskFix solves dozens of other disk problems as well.



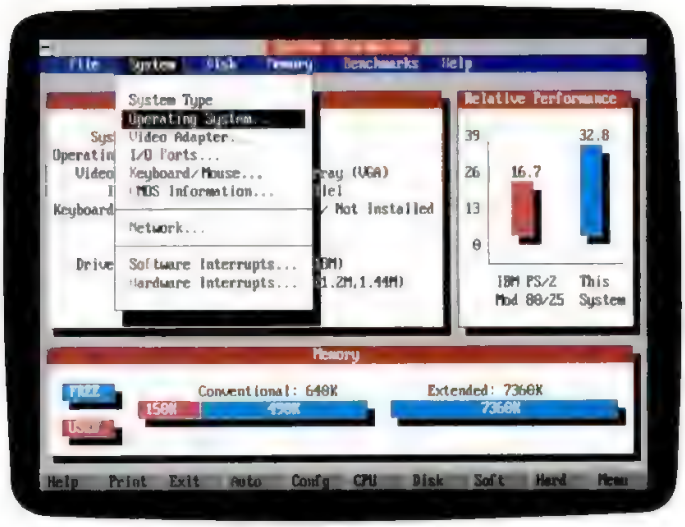
Desktop Manager. Now includes network-compatible workgroup calendars, a dBASE-compatible database, telecommunications with advanced MCI Mail support, notepads, calculators and more.



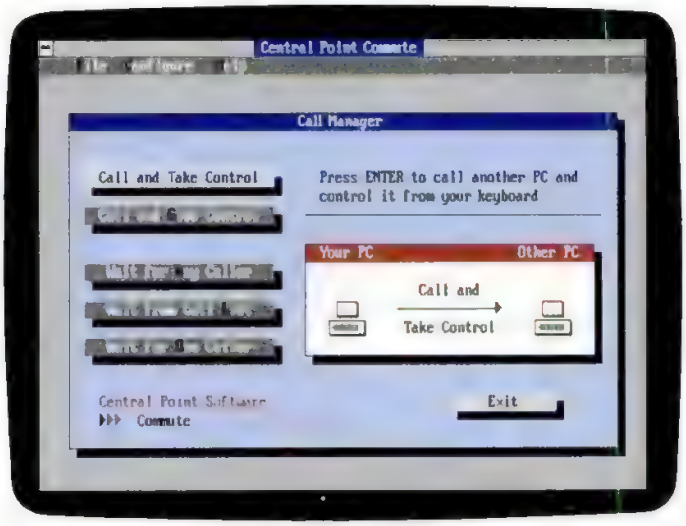
DOS and Windows Undelete. PC Tools' new Undelete can save erased files in a protected location – whether they're on a local or network drive. The DOS version lets you view data files from 30 popular applications.



Directory Maintenance. Locate and manage directories with a few keystrokes, even on large network disks. Prune and graft across drives, rename directories, change volume labels, even change NetWare attributes.



System & Network Information. Reports on over 160 attributes, including video, I/O, memory, mass storage, and four performance benchmarks. On NetWare, SI displays all servers, usage, users, and Novell groups.



Remote Computing. PC Tools Commute™ lets you take control of another PC, whether you're across town or across the country. Use it over a modem or LAN. You even get remote mouse support for Windows.

Introducing PC Tools™ 7.0.

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OK, OK, you also have to turn the page.

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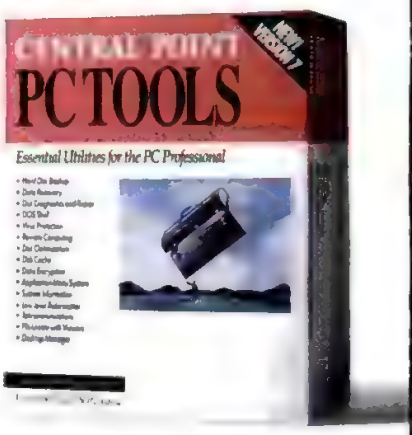

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CIRCLE 389 ON READER SERVICE CARD

BENCHMARK TESTS: DOS-BASED LANs

Contrary to traditional opinion, DOS-based LANs can carry heavy loads. While these products provide much less of a work load capability than *NetWare*, Version 2.15, running over its native operating system, they are powerful enough to provide file services for dozens of connected PCs.

TESTING ANALYSIS

We tested the DOS-based LANs not only against each other, but also against Novell's *NetWare*, Version 2.15, to compare their performance against a LAN that uses its own multitasking operating system.

These charts provide a great deal of information about the work load capabilities of the DOS-based LAN systems. The throughput scores seem to show near-parity among *NetWare*, *POWERlan*, and *WEB Network Operating System* in the speed with which a single station can retrieve and write data. But when you look at the total amount of work done on the LAN, as shown by the combination of the Workstation Evaluation Throughput results and the load test results, you see the power of *NetWare*'s multithreaded architecture over the sequential processing done by DOS.

Even so, some of these DOS-based LAN products provide excellent performance. *Invisible Ethernet NET/30*, *LANtastic*, *POWERlan*, *10Net Plus*, and *WEB* all proved capable of handling a work load equivalent to several client PCs simultaneously making requests to a single server through standard applications. But these results do not demonstrate the flexibility and power available in a network with multiple PCs acting simultaneously as clients and servers.

Two factors primarily determine performance in a DOS-based LAN: high-quality transport-layer software and a good disk-caching system. *WEB* uses Novell's own IPX to move data, so it hitchhikes on proven transport-layer software. It also uses a technique common in communications systems but rare in network systems: data compression. It compresses the data in the message fields to improve throughput, particularly when dealing with requests from applications for large data blocks.

Artisoft, DCA, Invisible Software, and Performance Technology have all spent a lot of time tailoring their NetBIOS software for reliability, compatibility, and performance. Performance Technology's fast *POWERlan* uses a protocol stack that includes both SMB and NetBIOS. The SMB/NetBIOS combination offers compatibility with many network products. Performance Technology also lets you fine-tune its disk-caching system with a menu-driven display.

DCA's *10NET Plus* also produced good results for a network providing SMB and an extended NetBIOS, but achieving optimum performance required much fine-tuning and adjusting of the buffers, cache, and drivers.

Artisoft's *LANtastic* performed solidly and reliably throughout all the tests. Easy to install and use, it provided its exemplary results with little or no fine-tuning of the server software.

These DOS-based LAN products had particularly interesting results on the Hard Disk Load with Background Printing test. Some programs could not handle the work load of simultaneously printing and servicing a steady stream of requests for disk activity. *Invisible Ethernet NET/30*, *LANsmart*, and *Solid LAN* all suspended printing under the demand of a heavy network load but then resumed when the heavy processing tasks were done. Likewise, *EasyNetwork* could not handle a print job and a network task at the same time. *GV LAN OS* reported a "printer hung" error under the combined print/network load; printing activity did not resume when the network activity diminished. The Hard Disk Load with Background Printing test simply would not run when we used *ReadyLink*; Compex could not resolve the problem. *LANtastic*, *POWERlan*, *10NET Plus*, and *WEB* have particularly strong, functional designs that can carry a heavy combined load.

The **Workstation Throughput Evaluation** test reports the throughput recorded on a single PC during the performance of a standardized task on the network and is run in conjunction with the Hard Disk Access Load test, the Hard Disk Access Load with Background Printing test, or the Directory Access Load test. The test program performs a sequential read, a random read, a sequential write, and a random write using a 1MB file. The record size systematically rotates among 16K, 4K, and 512 bytes. The throughput is reported in megabits per second.

The **Hard Disk Access Load** test reads random blocks of data in 1K increments from a 10K file on the server. The results of this test are reported in requests per second for all the PCs running the load test. The test begins and ends at the same time as the Workstation Throughput Evaluation test.

The **Hard Disk Access Load with Background Printing** test uses the same setup as the Hard Disk Access Load test, but it adds the load of a large network print job that constantly spools to a printer attached to the file server. The size of the print job is adjusted to keep it feeding to the printer throughout the load and throughput tests. The test begins and ends at the same time as the Workstation Throughput Evaluation test.

The **Directory Access Load** test makes the server repeatedly search for a nonexistent file. Since the file allocation table in network servers is typically cached, this request causes a fast read to the cache. The repeated retries created by the client PCs generate a heavy load on the server's CPU. This test provides a general-purpose method of loading the server's CPU in the fashion of a resident task, such as a network-monitor program or a communications program. The results for this test are reported in requests per second for all the PCs running the load test. The test begins and ends at the same time as the Workstation Throughput Evaluation test.

CONTINUES

Since our last review of *MainLan* (see First Looks, March 12, 1991, page 43), US Sage has begun bundling Multisoft Corp.'s *Super PC-Kwik* disk-caching utility. You must load the cache program separately from the network software and optimize it for your network applications. Many other products we reviewed load the cache automatically at the optimum default settings.

If you need help, US Sage offers free technical support at a toll number on weekdays for the first 30 days after purchase, from 9:00 to 6:00, E.S.T. You can also dial a bulletin board.

US Sage made a good move by going into the standardized Ethernet market. In a small office looking for a basic network operating system to share resources and communicate among several PCs, the 1-minute installation and easy-to-use system of *MainLan* make it a good choice.

POWERlan

by Kimberly Maxwell

Strength, performance, and versatility are the words that best describe *POWERlan* from Performance Technology. *POWERlan* users can access resources on a NetBIOS or *NetWare* network as if they were part of their own network. Flexible printing capabilities, high-performance speeds, and a polished user interface are equally good reasons for purchasing this solution. The basic *POWERlan* software, Version 2.10, sells for $795.

The package allows unlimited nondedicated and dedicated servers. A nondedicated server can support an unlimited number of users; you can set up an unlimited number of dedicated servers, but they are limited to five concurrent users each. (Using $219 Western Digital Elite 16-bit adapters, the cost per node for a ten-node

BENCHMARK TESTS: DOS-BASED LANs

PC LABS

HOW WE TESTED

Our test-bed consisted of a variety of 286-based computers acting as load stations and an ALR FlexNode from Advanced Logic Research, equipped with a 20-MHz 386 processor, as the single-node performance PC. (The accompanying topology diagram illustrates the basic network configuration.) We ran the Workstation Throughput Evaluation test separately on the ALR. We synchronized that station with the activity of as many as four other stations running the Hard Disk Access Load, Hard Disk Access Load with Background Printing, or Directory Access Load test to measure how much work the load stations did during the test, as well as the throughput of the single-node performance PC.

The graphs juxtapose the scores on the Workstation Throughput Evaluation test and the scores on the three load tests. This clarifies the relationship between the output of the PC running the throughput tests and of the stations running the load tests, as well as the overall work done by the network.

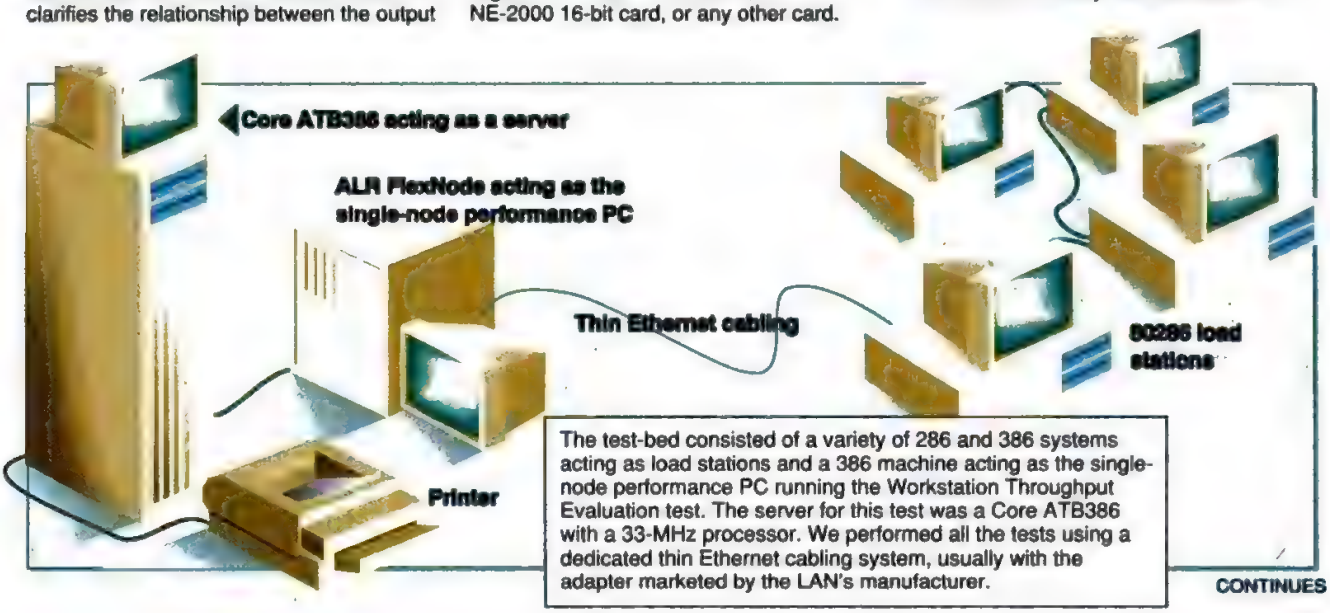
We ran the tests with zero, one, two, three, and four station loads. We report the results only for one and four stations, since these best highlight the products' performance as the network load increases.

CHOICE OF ADAPTERS

The server was a Core ATB386 using a 386 processor running at 33 MHz; it included 8MB of memory and a Core 300MB hard disk. In the PCs, we generally used the adapters marketed by each vendor. When the product was not bundled with adapters or the company preferred that we not use its own adapters, we gave the company the option of choosing a Western Digital Elite 16-bit card, a Western Digital 80013 EBT 16-bit card, a Novell NE-2000 16-bit card, or any other card.

Companies that selected Western Digital 16-bit adapters include Digital Communications Associates (*10NET Plus*), Performance Technology (*POWERlan*), and WebCorp (*WEB Network Operating System*); we used Everex 16-bit Speedlink PC adapters with Grapevine LAN Products' *GV LAN OS*. D-Link Systems (*LANsmart*) chose its own 16-bit card in the server, but 8-bit cards in the workstations; Exzel Corp. (*EasyNetwork*) and US Sage (*MainLAN Ethernet*) provided us with their own 8-bit cards for both server and workstations. All tests were done over a dedicated thin Ethernet cabling system and monitored by Network General Corp.'s Sniffer protocol analyzer.

PC Magazine LAN Labs' benchmark tests are written in C and are independent of commercial software. Each load station operates at a rate many times that of a PC, even one in a heavy-use environment.



The test-bed consisted of a variety of 286 and 386 systems acting as load stations and a 386 machine acting as the single-node performance PC running the Workstation Throughput Evaluation test. The server for this test was a Core ATB386 with a 33-MHz processor. We performed all the tests using a dedicated thin Ethernet cabling system, usually with the adapter marketed by the LAN's manufacturer.

CONTINUES

At Mount Sinai Hospital, some of the best brains in the country rely on Sony.

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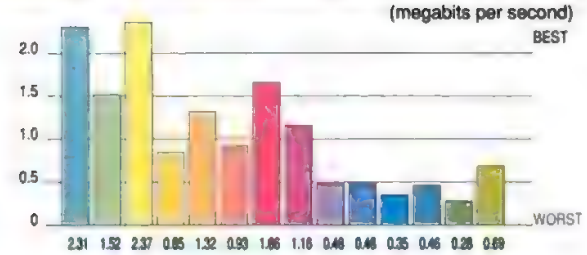
CIRCLE 337 ON READER SERVICE CARD

BENCHMARK TESTS: DOS-BASED LANs

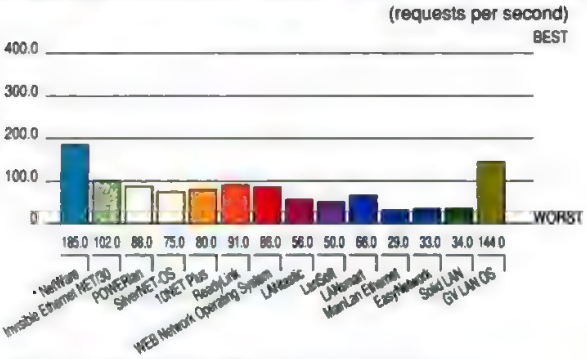
PC LABS

ONE STATION

Workstation Throughput Evaluation (a)



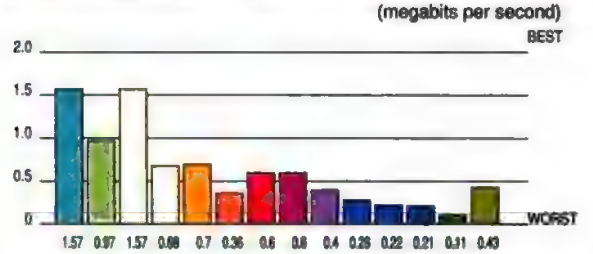
Hard Disk Access Load



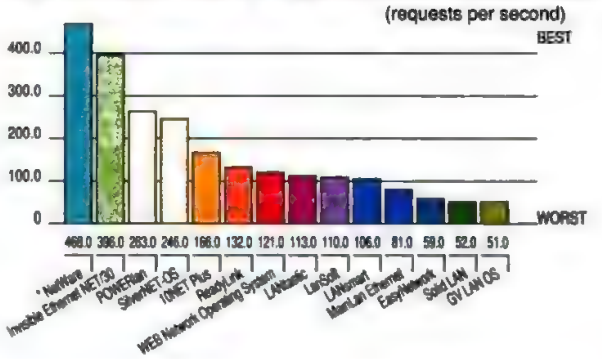
(a) Performed while the Hard Disk Access Load test is running.

FOUR STATIONS

Workstation Throughput Evaluation (a)

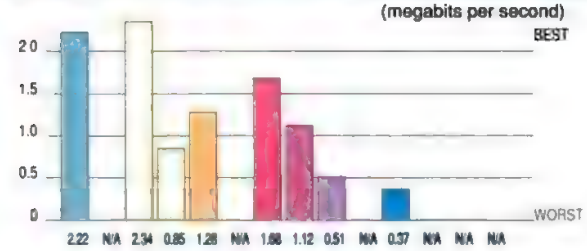


Hard Disk Access Load

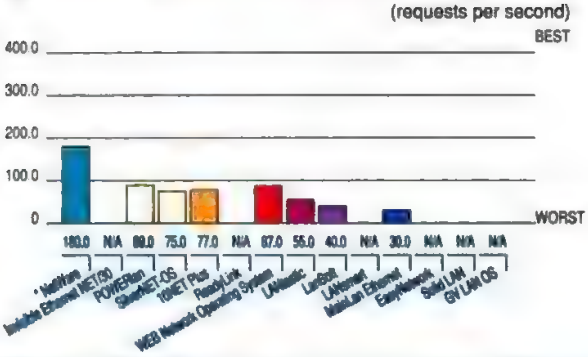


ONE STATION

Workstation Throughput Evaluation (b)



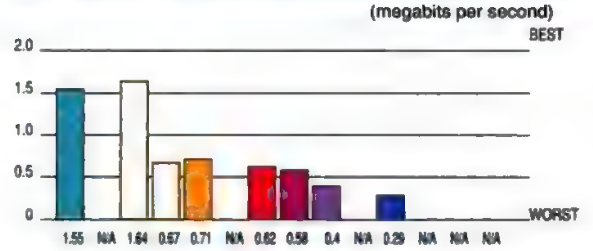
Hard Disk Access Load with Background Printing



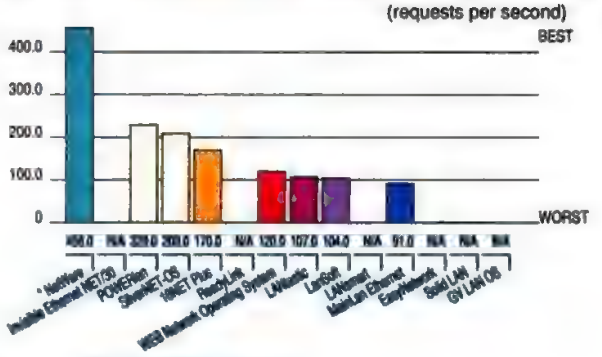
(b) Performed while the Hard Disk Access Load with Background Printing test is running.

FOUR STATIONS

Workstation Throughput Evaluation (b)



Hard Disk Access Load with Background Printing



* Reported for comparison.
N/A—Not applicable: The product did not complete this test.

	ONE STATION (Higher scores represent better performance)		FOUR STATIONS (Higher scores represent better performance)	
	Workstation Throughput Evaluation (a) (megabits per second)	Hard Disk Access Load (requests per second)	Workstation Throughput Evaluation (a) (megabits per second)	Hard Disk Access Load (requests per second)
* NetWare	2.31	185	1.57	468
Invisible Ethernet NET/30	1.52	102	0.97	396
POWERlan	2.37	88	1.57	263
SilverNET-OS	0.85	75	0.68	246
10NET Plus	1.32	80	0.70	166
ReadyLink	0.93	91	0.36	132
WEB Network Operating System	1.66	86	0.60	121
LANtastic	1.16	56	0.60	113
LanSoft	0.48	50	0.40	110
LANsmart	0.48	66	0.28	106
MainLan Ethernet	0.35	29	0.22	81
EasyNetwork	0.46	33	0.21	59
Solid LAN	0.28	34	0.11	52
GV LAN OS	0.69	144	0.43	51

(a) Performed while the Hard Disk Access Load test is running.

	ONE STATION (Higher scores represent better performance)		FOUR STATIONS (Higher scores represent better performance)	
	Workstation Throughput Evaluation (b) (megabits per second)	Hard Disk Access Load with Background Printing (requests per second)	Workstation Throughput Evaluation (b) (megabits per second)	Hard Disk Access Load with Background Printing (requests per second)
* NetWare	2.22	180	1.55	456
Invisible Ethernet NET/30	N/A	N/A	N/A	N/A
POWERlan	2.34	89	1.64	229
SilverNET-OS	0.85	75	0.67	209
10NET Plus	1.28	77	0.71	170
ReadyLink	N/A	N/A	N/A	N/A
WEB Network Operating System	1.68	87	0.62	120
LANtastic	1.12	55	0.58	107
LanSoft	0.51	40	0.40	104
LANsmart	N/A	N/A	N/A	N/A
MainLan Ethernet	0.37	30	0.29	91
EasyNetwork	N/A	N/A	N/A	N/A
Solid LAN	N/A	N/A	N/A	N/A
GV LAN OS	N/A	N/A	N/A	N/A

(b) Performed while the Hard Disk Access Load with Background Printing test is running.
* Reported for comparison.
N/A—Not applicable: The product did not complete this test.

CONTINUES

network is $298.) If you want ten more users on every dedicated server on your network, you must pay an additional $995. Or you can buy software for unlimited dedicated servers and users, at a total cost of $3,195.

The SMB-compatible system software comes equipped with special redirectors that allow *POWERlan* to interoperate with Novell's NetBIOS emulator or any NetBIOS network. Users can access both networks simultaneously by mapping to different drive letters. If you want your *POWERlan* network to access a Unix server, Performance Technology also offers *POWERfusion* (see "Unix Services for DOS-based PCs," *PC Magazine*, May 28, 1991). *POWERfusion*'s cost ranges from $750 for five clients to $3,000 for unlimited users, but it also varies depending on the Unix platform.

WIDELY SUPPORTED

The *POWERlan* package includes MS-DOS NetBIOS and OS/2 NetBIOS for Ethernet and ARCnet adapters, and provides support over 45 Ethernet and ARCnet cards from 22 vendors. You can also run *POWERlan* on a Token-Ring network using the Clarkson packet driv-

FACT FILE
EDITORS' CHOICE

***POWERlan*, Version 2.10**
Performance Technology Inc., 800 Lincoln Center, 7800 IH-10 West, San Antonio, TX 78230; 800-825-5267, 512-349-2000.
List Price: Unlimited nondedicated servers using unlimited-user version, $795; unlimited dedicated servers using 5-user version, $795; unlimited dedicated servers using 15-user version, $1,790; unlimited dedicated servers using unlimited-user version, $3,195.
Requires: 14K RAM in client PC, 32K RAM in nondedicated server or 2MB RAM of expanded memory in dedicated server, DOS 3.1 or later, appropriate ARCnet, Ethernet, or Token Ring adapter.
In Short: A top performer, *POWERlan* offers an array of network drivers, so you can run the network operating system over many vendors' cards. This package rolls together *cc:Mail*, network-administration and navigation utilities like *Navigate* and *POWERview*, and a powerful network operating system. Optional features let you use *NetWare* and Unix servers simultaneously with *POWERlan* servers. Good security features, intelligent printing control, and a host of other options make this an excellent choice for a DOS-based LAN.

CIRCLE 602 ON READER SERVICE CARD

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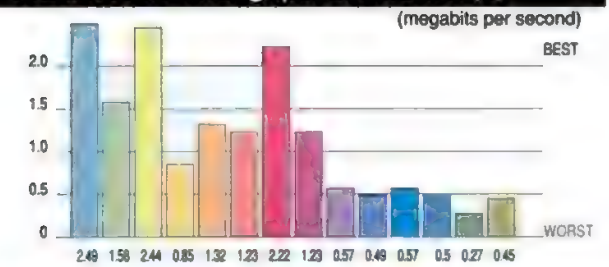
CIRCLE 322 ON READER SERVICE CARD

BENCHMARK TESTS: DOS-BASED LANs

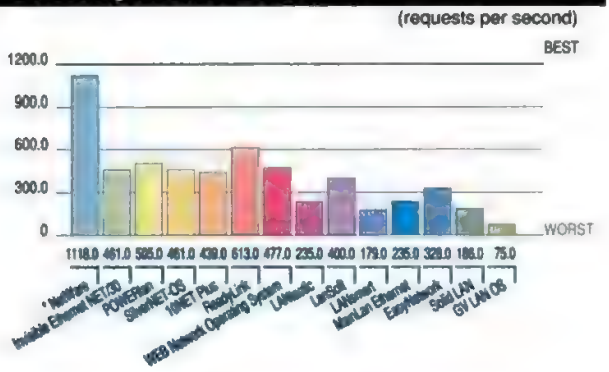
PC LABS

ONE STATION

Workstation Throughput Evaluation (c)



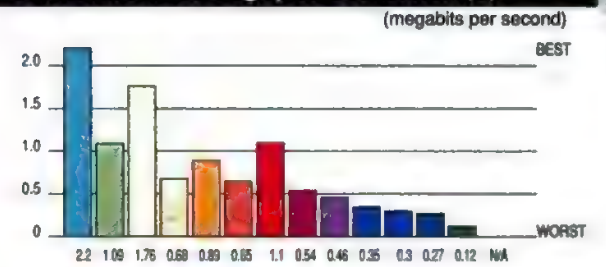
Directory Access Load



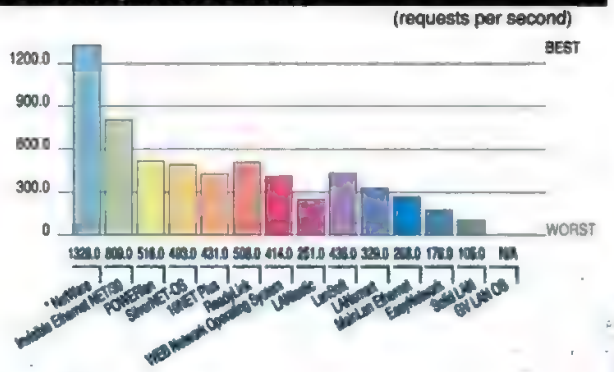
(c) Performed while the Directory Access Load test is running.

FOUR STATIONS

Workstation Throughput Evaluation (c)



Directory Access Load



* Reported for comparison.
N/A—Not applicable: The product did not complete this test.

POWERlan swept all of the performance categories on our benchmark tests.

ers or IBM's NetBIOS for Token-Ring.

We ran *POWERlan* over Western Digital's 8013 16-bit Ethernet cards. With a dedicated, fine-tuned server, *POWERlan* swept all of the performance categories on our benchmark tests. You won't see the same performance from a nondedicated server, but this software can carry very heavy processing loads. A single workstation achieved a maximum throughput of 2.6 megabits per second and sustained at least 1.6 megabits per second while working the other network stations harder than any other network operating system. You can install this software in almost any organization with great confidence that it will carry your processing load.

POWERlan comes with an eight-user version of *cc:Mail*, a full-blown third-party store-and-forward mail system. Performance Technology also bundles some of its own network utilities. *POWERview*, a remote screen-access utility, lets you view network usage and activity from a dedicated server. The *Navigate* utility allows you to browse the entire network for files and resources. You also get a local backup program called *POWERsave* that includes drivers for QIC (quarter-inch cartridge) and QIC-SCSI. If you need a network-wide backup solution, you can upgrade *POWERsave* for $1,495. Performance Technology also sells hardware/software solutions called POWERsave Backpacks, ranging in price from $4,295 to $7,995, depending on the type of backup solution and your network configuration. *POWERlan* allows you to set a time for unattended backups to avoid bringing down the network during periods of heavy use.

Installing *POWERlan*, which includes its own disk cache, takes less time than configuring the system. The program creates the AUTOEXEC.BAT and CONFIG.SYS files and sets up each machine with default settings. *POWERlan* requires 14K RAM to run as a workstation and 32K RAM as a nondedicated server. The manufacturer recommends 2MB of expanded memory to run a *POWERlan* dedicated server, but the system can use up to 32MB of expanded memory for disk caching. Dedicated servers must be 386- or 486-based machines. *POWERlan*'s mouse support lets you point and shoot your way through the menu system. You can also run the software from the command line.

	ONE STATION (Higher scores represent better performance)		FOUR STATIONS (Higher scores represent better performance)	
	Workstation Throughput Evaluation (c) (megabits per second)	Directory Access Load (requests per second)	Workstation Throughput Evaluation (c) (megabits per second)	Directory Access Load (requests per second)
* NetWare	2.49	1,118	2.20	1,328
Invisible Ethernet NET/30	1.58	461	1.09	809
POWERlan	2.44	505	1.76	516
SilverNET-OS	0.85	461	0.68	493
10NET Plus	1.32	439	0.89	431
ReadyLink	1.23	613	0.65	508
WEB Network Operating System	2.22	477	1.10	414
LANtastic	1.23	235	0.54	251
LanSoft	0.57	400	0.46	436
LANsmart	0.49	179	0.35	329
MainLan Ethernet	0.57	235	0.30	268
EasyNetwork	0.50	328	0.27	176
Solid LAN	0.27	186	0.12	105
GV LAN OS	0.45	75	N/A	N/A

(c) Performed while the Directory Access Load test is running.
* Reported for comparison.
N/A—Not applicable: The product did not complete this test.

ENDS

RESOURCE MANAGEMENT UTILITIES

To speed the setup of similar groups of users, *POWERlan* lets you create templates for shared devices or disks. The PLADMIN utility lets you control network administration centrally at a security server. (It can be run from a workstation, with a loss of some capabilities.) Security measures include creating user log-on files and setting up user access and privileges. You can limit the number of allowed log-on attempts to discourage would-be intruders who try to fish for a password. A keyboard lock helps protect the server from unauthorized usage and possible shutdown.

If you want to set up printers or use the *Navigate* resource-management program, you can access these utilities through PLADMIN's main menu. The PLQ utility lets you control print jobs, administer unspoolers at various print servers, and manipulate print-job and unspooler queues. Instead of submitting print jobs to specific printers, users send them to a server with a print profile that contains a set of printing attributes, such as a laser printer with blue paper. The software then unspools print jobs to available printers that match the print-profile attributes, while it spools newly requested print jobs at a centralized print server.

The product supports remote boots and shared CD-ROM drives, although it lacks a chat feature. If you ever have difficulty with *POWERlan*, its complete on-line help guide should assist you. A global search utility lets you search by topic or keyword. If you need further help, you can arrange for contracted technical support, available weekdays at a toll-free number from 8:00 to 5:00, C.S.T., or through a bulletin board service.

You can't ignore this powerhouse. *POWERlan*'s features speak for themselves; its speed convinces. With a wide array of network drivers and the ability to interoperate with NetBIOS and *NetWare* networks, *POWERlan* gives users a complete DOS-based LAN solution.

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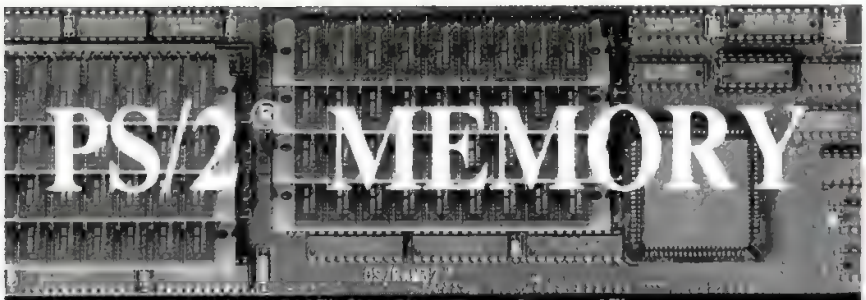

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FACT FILE

***ReadyLink*, Version 2.01**
Compex Inc., 4055 E. La Palma, Unit C, Anaheim, CA 92807; 714-630-7302.
List Price: Starter kit with 16-bit Ethernet card, software for 255 users, cabling, terminators, $699; starter kit with 8-bit Ethernet card, $599; 16-bit Ethernet adapter, $199; software alone, $299.
Requires: 80K RAM in client PC, 133K RAM in non-dedicated server, DOS 3.0 or later, appropriate ARCnet, Ethernet, or Token-Ring adapter.
In Short: *ReadyLink* gives adequate throughput so users can share resources and send messages effectively. Like competing products, it also offers the ability to expand to a larger network operating system by reusing the network cards. Drawbacks include an eccentric menu system, heavy RAM consumption, and the danger of losing messages if you don't save them to a disk or printer. The price is a plus.

CIRCLE 603 ON READER SERVICE CARD

ReadyLink

by Kimberly Maxwell

Compex's *ReadyLink* provides an affordable network solution, particularly if you may want to connect to another network. By itself, *ReadyLink*, Version 2.01, lets users share drives and network devices, and exchange messages from either the DOS command line or a menu. The package also includes adapter cards that you can use for simultaneous connections with other systems, such as *NetWare*. In a ten-node system, *ReadyLink* costs a reasonable $229 per node for the hardware and software. It achieves good throughput.

Compex, a company known mainly as an OEM of Novell's *NetWare*, sells its *ReadyLink* Ethernet network startup kit for $699. Each kit includes two 16-bit Compex Ethernet cards, system software for 255 users, cables, T-connectors, and network drivers. The system software can be bought separately for $299, and the 16-bit Ethernet adapter boards sell separately for $199 each. A less expensive two-station Ethernet starter kit using 8-bit cards sells for $599, and the two-station ARCnet starter kit sells for a low $499. If in the future you decide to expand to a larger network, such as *NetWare*, the Compex hardware can be reused. In fact, the adapters are Novell-certified.

CONNECTING TO NOVELL

With *ReadyLink*, you can connect two workgroups through one workstation, one running *ReadyLink* and another *NetWare*. With two *NetWare*- and *ReadyLink*-compatible adapters installed, a station acts as a drop-off point for data. In effect, this makes the workstation a server, although it doesn't need to be dedicated. You can download data from the larger *NetWare* network onto the special workstation's hard disk, and from there, onto machines on the smaller *ReadyLink* network. *ReadyLink* is not the only network operating system that can do this, but Compex seems to be the only manufacturer stressing this configuration in its marketing.

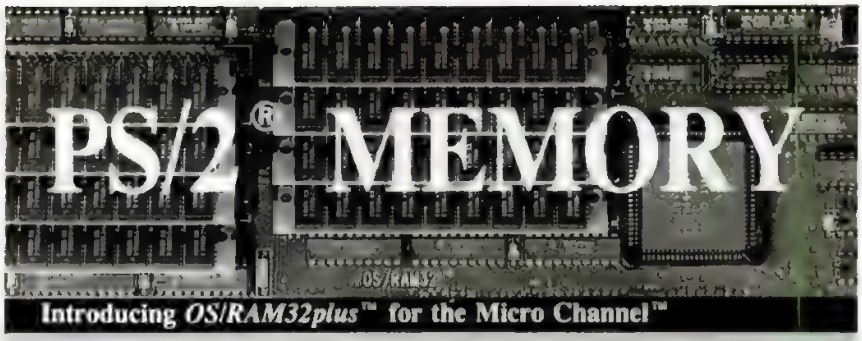
With *ReadyLink*, you can connect two workgroups through one workstation, one running *ReadyLink* and one running *NetWare*.

You can configure each machine on the *ReadyLink* network as a dedicated server, nondedicated server, or plain-vanilla workstation. You can also set up the network as a peer-to-peer LAN. The uncomplicated installation process takes only minutes. The network adapters come with a diagnostic utility to help you set them up.

The memory requirements for *ReadyLink* vary with each machine setup. For example, a minimum server station configuration includes modules totaling 133K of RAM, plus the space needed by DOS. When you configure a PC as a network client only, the needed modules still occupy 80K, a significant amount compared to several other products in our review.

A memory manager built into the operating system helps utilize expanded memory. *ReadyLink* uses a portion of base memory and expanded memory for network housekeeping functions, but uses expanded memory mainly for 16K of data buffering of the workstation's redirector. Since the LIM driver takes about 8K of that buffer, you gain only about 8K of useful RAM.

Performance has improved with *ReadyLink*'s new disk cache; throughput has doubled since we last looked at it.



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CIRCLE 151 ON READER SERVICE CARD

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IMPROVED CACHING

The system software includes a third-party disk cache, DAC Easy's *Lightning*. When we reviewed *ReadyLink* in First Looks ("ReadyLink: Low-Cost, Entry Level DOS-based LAN," February 26, 1991, page 46), Compex included its own self-configuring disk-caching utility for the server. At that time performance was slower; with the new disk cache, throughput has doubled. *ReadyLink* performs well, running in the middle of the pack on our benchmark tests.

ReadyLink offers optional Message and Menus modules. Message provides a simple e-mail facility, enabling you to exchange mail with other network users, either from the DOS command line or the menu system. While the message feature is minimal, it provides a useful on-line e-mail system for trading short messages. The default message size is 128K, but can reach a maximum of 512K. If you do not specify whether you want to save a message or print it, the message will automatically clear from memory, eliminating future retrieval. The Menus module allows users to perform file transfers, share devices, and use all the network operating system utilities.

However, the menu system doesn't include the kind of conventional pull-down menus found in other programs. The main menu bar sits in the top portion of the screen, with the subscreen boxes popping up in the top-left corner of the screen, rather than directly under your selection. The menus in competing products are easier to manipulate because they follow a standard menu-system format.

ReadyLink provides an adequate network security option, but it's no better than many competing DOS-based LAN packages. Like other programs we reviewed, it offers password protection and privilege rights for subdirectories and files, but it lacks the ability to control user log-on times as well as a keyboard lock feature.

The program's printing features are not extravagant, but they fill basic printing needs. You can display a print queue, customize separator pages, and check print status. But during testing, we found problems with the printing redirector that caused some erratic benchmark test results: We had problems running *ReadyLink* through our Hard Disk Access Load with Background Printing test. At press time, we were unable to determine the cause of the printing failure in our system, and the company was unable to help.

Compex provides free technical support at a toll number on weekdays, from 8:00 to 5:00 P.S.T. The company also operates a bulletin board service.

By the time you read this, Compex should be shipping *ReadyLink Plus*. This new version, selling for the same price of $299 per network, will include the ability to launch applications. It will also provide other features, including task switching. The key to *ReadyLink* is its low cost and ability to expand easily to work with *NetWare*. It provides an economical network system for small- and medium-size offices.

SilverNet-OS

by Sara Parker

There's a new player in the peer-to-peer LAN ball game. Net-Source's *SilverNet-OS*, released in January 1991, already shows promise. Easy to use, it offers relatively good performance and a low memory overhead. The product also supports the SMB (server message block) protocol, making it useful for connections to Unix systems. In a ten-node network, the hardware/software package costs a reasonable $333 per node.

SilverNet-OS is reasonably priced at $699 for a starter kit that includes two 16-bit Ethernet adapters, software for two users, a 25-foot coaxial cable, terminators, connectors, and NetBIOS drivers. Additional nodes cost $329 each, including both hardware and single-user software. Net-Source also offers an 8-bit Ethernet card that sells for $299 per node, or $649 for the starter kit.

Net-Source targets small and medium-size companies, as well as small work-

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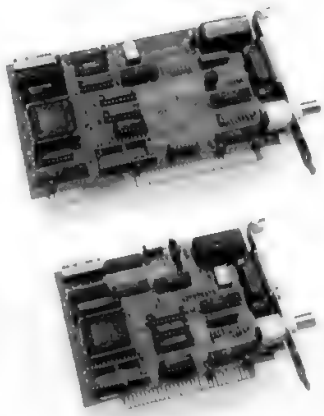
To make your network even less work, Everex Ethernet cards also come with the Everex-WEB peer-to-peer network operating system—a system specifically designed with the non-technical user in mind. Not only is Everex-WEB compatible with any network card that features a NetWare driver, but it is extremely easy to install and operate, and can be up and running with just a few keystrokes.



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CIRCLE 130 ON READER SERVICE CARD

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FACT FILE

***SilverNet-OS*, Version 1.0**
Net-Source Inc., 1265 El Camino Real, Suite 101, Santa Clara, CA 95050; 408-246-6679.
List Price: Ethernet starter kit with two 16-bit adapters, software for two users, 25-foot coaxial cable, connectors, terminators, $699. Additional users, including 16-bit Ethernet card and single-user software, $329 each. 8-bit Ethernet card, $299.
Requires: 31K RAM in client PC, 41K RAM in nondedicated server, DOS 3.3 or later, ARCnet, Ethernet, or Token-Ring adapter.
In Short: The *SilverNet-OS* peer-to-peer entry-level LAN combines low memory overhead with ease of use. It doesn't have a lot of extras, and even lacks some common features, such as the ability to make a server dedicated. But it provides reasonable performance. With SMB support in the current version, this new player looks promising.

CIRCLE 604 ON READER SERVICE CARD

groups in large corporations. *SilverNet-OS* can run in the Unix environment, and it supports all NetBIOS network interface cards. Its Ethernet adapters use the National Semiconductor chip set. Since they are also NE-1000–compatible, future migration to *NetWare* becomes a cost-efficient option.

Installation is short and simple: Answer a few questions and your network operating system is installed and ready to link PCs. The file server requires 41K RAM, while the client station needs 31K. The installation process does not revise your CONFIG.SYS or AUTOEXEC.BAT file. You also cannot make the server dedicated. You can configure stations only as file servers, print servers, or client PCs. Because *SilverNet-OS* includes neither disk-cache software nor a dedicated server configuration, it has middling throughput.

Installing *SilverNet-OS* is simple: Answer a few questions and you're ready to link PCs.

RELIABLE BUT MODEST PERFORMANCE

SilverNet-OS performed reliably but modestly, with a maximum throughput of just under a megabit per second. It managed to sustain reasonable throughput under heavy loads and continued to print reliably, even when the hard disk and the network were very busy. We used the DOS SMARTDRV.SYS disk-caching program with extended memory during our tests.

SilverNet-OS doesn't take advantage of extended or expanded memory itself, but with the ability of DOS 5.0 to load software into high memory, that will not be as much of a drawback as it once was. And although it has no built-in memory manager, you can use third-party memory-management software.

Printing capabilities with *SilverNet-OS* are pretty basic. You can look at the print

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CIRCLE 500 ON READER SERVICE CARD

Net-Source's *SilverNet-OS* is easy to use and has low memory overhead; with a few added features, it could become a major player in the peer-to-peer LAN market.

queue to see the status of your print job and delete jobs already in the queue, but you can't change the status of print jobs or customize separator pages.

FAIR SECURITY

Security features rate as fair. You can assign access levels such as read, write, and create to network directories and set up passwords. If you assign a password to an entire subdirectory, you can restrict access to files in that subdirectory to those people with the password.

TECH SUPPORT

SilverNet-OS lacks some of the extras found in most operating systems we reviewed, including an e-mail system and the ability to track resource usage and display active users. The file-server, however, can access menus describing the resources available through the network. If you need technical assistance, Net-Source provides it weekdays from 9:00 to 4:00 P.S.T. on a toll line.

SilverNet-OS justifies its claims to ease of use and low memory overhead. It's not the top performer in this review, but the product shows promise for future releases. If it should add features like a built-in disk cache, the ability to make a server dedicated, and the ability to support CD-ROM drives over the network, *SilverNet-OS* could easily become an important player in the peer-to-peer LAN market.

D	U	M	L	A	L	C	I	H	E
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P	I	J	U	Z	P	T	H	O	U
V	O	I	A	D	O	B	E	N	X
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R	A	H	O	E	A	U	X	R	N
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W	G	U	O	A	E	I	L	Z	Z
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Solid LAN

by Kimberly Maxwell

Solid features are plentiful in the DOS-based LAN competition. Solid Technologies demonstrates this fact with *Solid LAN*. With this package, users can share drives and resources, and chat in real time with ease. The price, $359 per node regardless of the number of nodes, includes either an 8-bit or 16-bit Ethernet card, network system software for unlimited users, and T-connectors. Proprietary 1.8-megabit-per-second twisted-pair cards with software sell for $215 each.

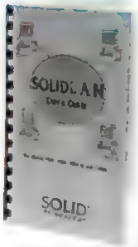
Each Ethernet adapter comes with drivers to run with not only *Solid LAN*, but also with CBIS's *Network-OS*, IBM's *PC LAN*, and Torus's *Tapestry*. You can also request drivers for Novell *NetWare*, allowing you to reuse the cards in case you set up a *NetWare* network. But since the *Solid LAN* software is hardware-dependent, you cannot run it over other companies' cards.

We tested the system with 16-bit Ethernet cards. Unfortunately, it proved to be a lackluster performer on our throughput tests, and the printer stopped during our Hard Disk Access Load with Background Printing test.

INSTALLING TO FIT

You have two methods to choose from: a quick-install option or a manual installation that allows you to fine-tune the network to fit your needs. When you set up your network, you configure each station as a dedicated or nondedicated server, or as a client PC. The installation program

FACT FILE



***Solid LAN*, Version 2.61**
Solid Technologies, 333 S. Beverly Dr., #110, Beverly Hills, CA 90212; 800-422-2966, 213-785-0030.
List Price: $359 per user, including 8- or 16-bit Ethernet card, software for unlimited users, connector.
Requires: 20K RAM in client PC, 60K RAM in server, DOS 3.1 or later, appropriate Ethernet or proprietary adapter.
In Short: A product with basic but solid network features, including memory management, real-time chatting, and disk caching. A useful polling program lets you know if all the stations are communicating with each other, but *Solid LAN*'s performance was not impressive.

CIRCLE 606 ON READER SERVICE CARD

automatically modifies your AUTOEXEC .BAT and CONFIG.SYS files to include a set of standard defaults. Support for remote-boot ROM allows diskless workstations to boot from the server.

Solid LAN includes a polling program which verifies that the network stations are communicating with each other. A display lists each station detected by the program. If some stations do not appear, check the cabling or the adapter's address.

WHATMEM, a memory map utility, lists the memory found in each machine. *Solid LAN*'s built-in memory manager requires some specific setup procedures that depend on the type of motherboard, memory board, and video boards found in each machine. You may have to add certain parameters to the CONFIG.SYS file to make the EMS manager work properly. A user manual gives you help in customizing the memory configuration.

Without EMS, all of the product's features add up to only 20K RAM in the client PC and 60K in the nondedicated server. If you install the EMS utility, you can get the server RAM down to only 13K, with 3K in the client PC.

The software includes a disk-caching program called Solid Cache. To use Solid Cache, your machine must have extended or expanded memory. The manual gives a detailed description of ways to set cache and network parameters for better performance. The on-line help facility can also assist you.

SEVERAL TYPES OF MESSAGES

Solid LAN provides several ways for users to communicate. The memory-resident message utility occupies as little as 2K RAM and allows you to broadcast one-line messages to individual users, or even across the network. The store-and-forward e-mail capability permits you to send full-screen messages and reply to them, attaching files with ease. The real-time chat feature lets you interact with other people on the network. When you want to chat with a user, you simply send a request, the user responds, and your screen splits into two sections. One section includes your local machine's screen for your messages, while the second contains the other party's chat area.

The package's basic printing abilities include controlling files on a network printer, examining the print spooler status and print queue contents remotely, and modifying them by deleting or delaying jobs in the queue. Simple resource management can take place in either the menu system or the DOS command line mode.

If you want a DOS-based LAN product with all the features found in competing products, do not overlook *Solid LAN*. Despite the lackluster throughput, it has a good range of basic capabilities.

10NET Plus

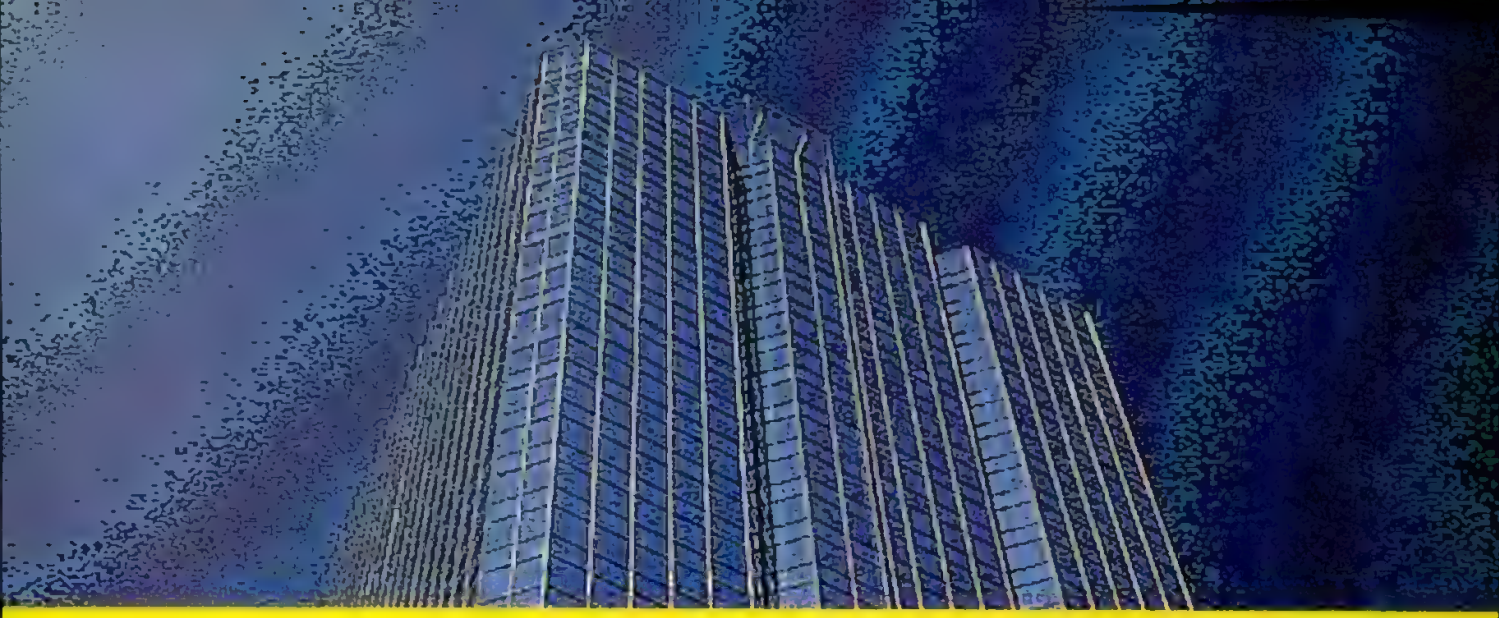
by Sara Parker

Digital Communications Associates Inc. (DCA) has added some important features to its already feature-laden peer-to-peer network operating system, including support for *Microsoft Windows* 3.0. Easy to install and use, it offers several RAM-saving alternatives.

The $129 base pack we reviewed included software for one node and a six-user license for Consumer Software's *The Network Courier* e-mail system. You can purchase a three-user license for *10NET Plus* for $299, a five-user license for $449, and a ten-user license for $799. (DCA also sells an upgrade to a 20-user license.) If you exceed six users, you must also purchase extra nodes for the e-mail system .

Solid Technologies' *Solid LAN* includes a polling program which verifies that the stations on the local area network are communicating with each other.

DCA offers an array of Ethernet adapter cards that support NDIS, NetBIOS, and IPX protocols (the product runs on any adapter with NetBIOS). Although DCA offers its own 8-bit adapters, the company advised us that their cost at the time of our



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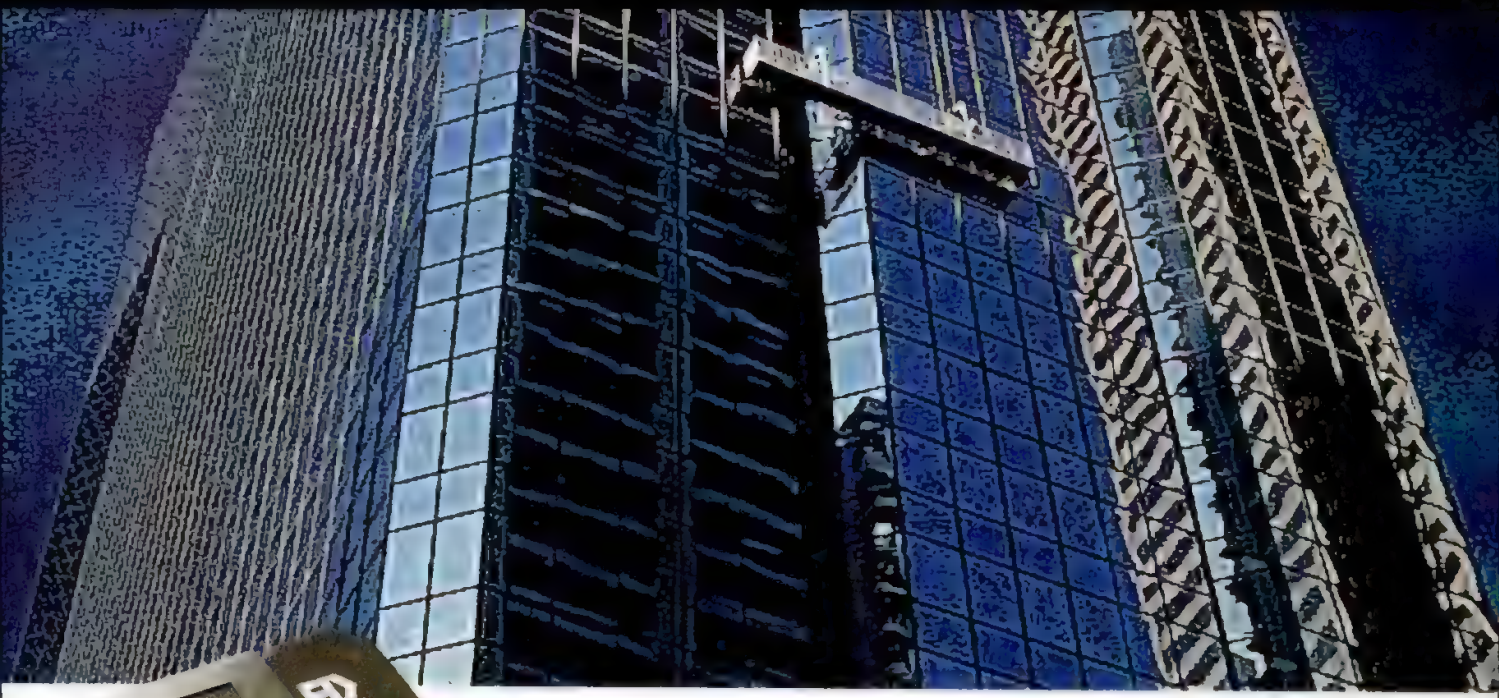

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Products that support industry-standard open protocols often sacrifice speed for bulk, but *10NET Plus* moved along smartly.

review would raise the price beyond $375 per node. DCA suggested we run *10NET Plus* over Western Digital adapters, so we tested the system on $219 Western Digital Elite 16-bit adapters using NDIS drivers. The combined price of the software and hardware comes to $312 per node, including the initial cost of the base pack. At press time, DCA had lowered prices on its twisted-pair and coaxial cards.

10NET Plus includes the 10BEUI protocol, an extension of NetBIOS that resembles IBM's NetBEUI. *10NET Plus* includes not only a DOS version of the system software, but *10Windows*, which lets you use the Clipboard utility and chat with DOS and *Windows* users simultaneously. Unlike the *Windows* version, the DOS version does not support a mouse. The system is also interoperable with OS/2's *LAN Manager*.

SPEED WITH OPEN PROTOCOLS

We were surprised to see good performance from a product with so many layers of software. Typically, products that support the industry-standard open protocols published by IBM and Microsoft sacrifice speed for bulk, but *10NET Plus* moved along smartly on all of our tests. It was one of the top performers on our benchmark tests and did an excellent job of keeping data moving on the network while simultaneously printing from our combined file/print server.

Installation is short and simple. Before modifying your CONFIG.SYS and AUTOEXEC.BAT files, *10NET* shows you what they will look like. You can config-

PC MAGAZINE FACT FILE

***10NET Plus*, Version 4.20.20**
Digital Communications Associates Inc., 1000 Alderman Dr., Alpharetta, GA 30202-4199; 800-348-3221, 404-442-4000.

List Price: Base pack, with software for one user, e-mail license for six, $129; 3-user version, $299; 5-user version, $449; 10-user version, $799; 20-user version, $1,379. E-mail license for 100 users, $695.

Requires: 29K RAM in client PC, 70K RAM in nondedicated server, DOS 3.1 or later, appropriate ARCnet, Ethernet, or Token-Ring adapter.

In Short: A tried and true product, *10NET Plus* is chock-full of features. With the added *Windows* and NetBEUI support, *10NET Plus* remains on the leading edge of the peer-to-peer LANs. This speedy package bundles *The Network Courier* and provides a workgroup calendar facility and good printing control. It also provides a detailed security scheme, although managing security can be daunting on a large-scale system. *10NET Plus* is worth your attention.

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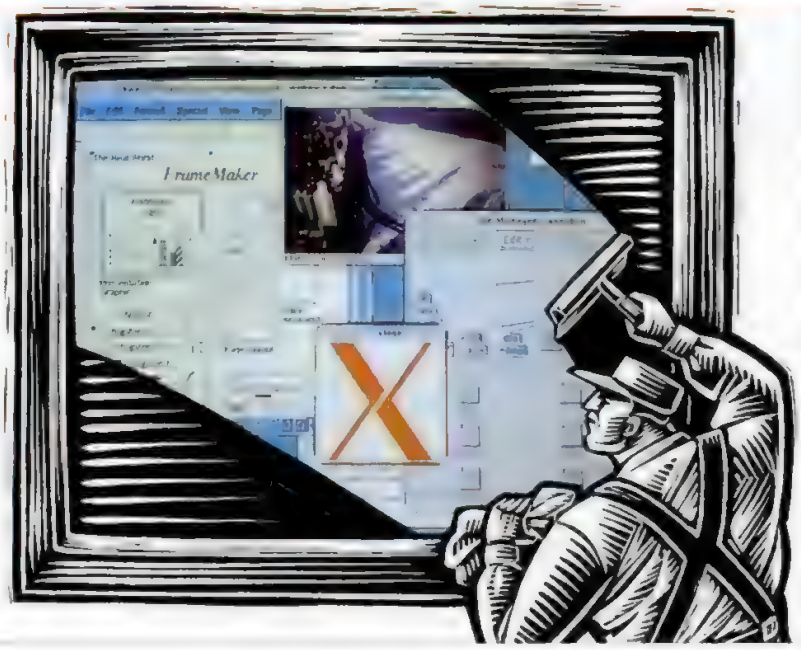

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Menus make *10NET* especially easy to use; one utility even lets end users view diagnostic network information.

ure *10NET* as either server-based or peer-to-peer, and set up stations as client PCs, print servers, or file servers. PCs configured as file servers use 70K of RAM, while those configured as clients use 29K.

10NET includes several memory-management options. You can load the entire code segment into extended memory and expanded memory. The operating system can also take advantage of third-party memory managers like Quarterdeck Office Systems' *QEMM-386;* the built-in memory manager only loads *10NET*'s program components into high memory. You can run *10NET*'s high-performance disk cache, 10CACHE, on your server and workstations.

POWERFUL, VERSATILE FEATURES

10NET is a powerful, versatile operating system. One of the few features it lacks is remote-boot ROM capabilities. But *10NET* does let you remotely start programs and processes on a PC across the network. If you want to start a database or file-backup program running a predefined task, you can submit the commands through *10NET*, and the program will load and run on a specified PC. If the PC is currently busy with another task, the submission waits in a queue.

10CAL, a workgroup calendar included in the package, helps create and maintain users' individual schedules. Easy to set up, the well-documented calendar program identifies schedule conflicts and also recommends times when all identified parties will be available.

10NET's top-notch printing capabilities allow you to view the print queue and change the priority of print jobs. You can customize separator pages and resume a print job from where it stopped if, for example, you ran out of paper. In the *Windows* version, a convenient on-screen message tells you when your print job is complete. *10NET*'s *Windows* option supports *10NET* print spooling and the *Windows* spooler.

The e-mail system we saw was a bundled version of the sophisticated package *The Network Courier*. (At press time, however, Microsoft had purchased *The Network Courier* and renamed it *Microsoft Mail*.) It has all of the standard e-mail features, but goes even further. You can send mail to individuals or groups, attach text files to your messages, sort your mail several different ways, encrypt your messages, and respond to incoming messages without exiting your current application.

Menus make the *10NET* operating system especially easy to use. The REMSTAT utility lets every station monitor the network resources. REMSTAT gives valuable information to the LAN administrator about allocated, free, and peak resources, helping to determine whether the

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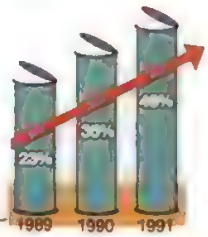
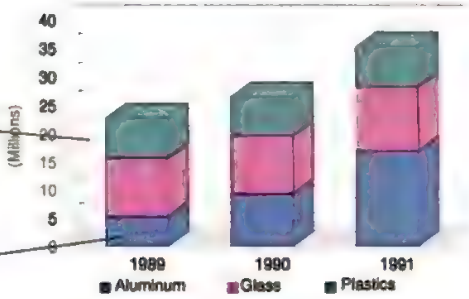


This study conducted by the Materials Research Group provides the basis for our most recent recommendation that WeCycle continue to expand its aluminum recycling capacity by another 70% over the next 6 years. The graph to the right shows the increasing proportion of our business provided by the aluminum division during the past three years, now approximately half of all revenues. It is our opinion that, at this rate of growth, aluminum recycling will continue to offer our company its greatest opportunity for expansion over the next decade, and certainly into the 21st century.

Gross Revenues by Product



WECYCLE PRODUCT	1989	1990	1991
Aluminum			
East	2,323,426	4,019,527	7,315,539
Central	1,372,347	2,374,160	4,320,972
West	1,726,492	2,986,831	5,436,033
Total	5,422,265	9,380,518	17,072,544
Glass			
East	2,496,721	2,567,821	2,798,925
Central	3,598,757	3,217,693	3,507,285
West	4,217,635	4,471,294	4,873,710
Total	10,313,113	10,256,808	11,179,920
Plastics			
East	2,897,493	3,171,243	3,234,668
Central	1,873,938	1,823,697	1,860,171
West	2,378,942	1,967,421	2,006,769
Total	7,150,373	6,962,361	7,101,608

Glass and Plastics

As can be inferred from the graph to the left, glass and plastics recycling has been holding steady throughout this same period, and has consequently become a smaller proportion of our overall sources of revenue.

Although this group would strongly recommend that WeCycle Waste Corporation do all that is necessary to increase its activities in these areas, our studies have shown that aluminum will become increasingly the material of choice in the shipping, heavy manufacturing and container industries.

Aluminum

It is our opinion that sources of aluminum products will be pressed close to their limits over the next decade.

Therefore, we propose that WeCycle Waste Corporation invest in more aluminum capacity during the next five years in order to take the best advantage of this increasing market demand.

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automatically.

hold freehand drawings or symbols to call attention to critical data.

A feature that only 1-2-3 offers to DOS spreadsheet users is the ability to embed as many "live" graphs on a worksheet as you'd like.

improved 3D-glass graphs can add even more impact to your report.

Like total, replace, and other, which hold formulas to values, or are 100 text style combinations — which helps save other spreadsheets.

Thanks to Auto Command, you can easily create an entire report in one page.

de your spreadsheet ng your hardware.

There's a lot to like about the new Lotus® 1-2-3® Release 2.3.

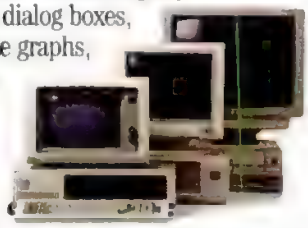
For starters, it's not just a graphical spreadsheet. It's a fast, graphical spreadsheet for DOS. It's easy to use. And it works as well on an older XT with just 512K of memory as it does on the newest 486 machine.

It also shares many features in common with our powerful 3D spreadsheet, Release 3.1. Including its superb spreadsheet formatting and publishing capabilities and full mouse support. Along with its popular Auto Compress feature that gives you a trouble-free way of making larger worksheets print on a single page.

We've also added new features you won't find in other spreadsheets. Like the Viewer (based on Lotus Magellan® technology) which helps you find the file you want before retrieving it. And a very helpful Auditor that simplifies the job of documenting and analyzing complex worksheet logic.

With its WYSIWYG graphical environment, you can do all your formatting "live" on screen.

Of course, you won't just like what Release 2.3 does. You'll like how it feels. It's quick and smooth. With a WYSIWYG (what-you-see-is-what-you-get) graphical environment that lets you format text, data, and graphics "live" on screen. Plus, what you see on screen is what you'll get when you print. With the mouse, you can execute commands, highlight cells or ranges, open dialog boxes, place and size graphs, change type styles, fonts and point sizes. All with unparalleled speed and ease.



Lotus 1-2-3 Release 2.3 runs smoothly and quickly no matter what hardware you're running it on.

What's more, Release 2.3 gives you a wide range of printing and reporting capabilities. Including the capacity to place as many live graphs on a worksheet as you'd like.

Along with 96 type style combinations, new 3D-effect graphs, drawing and annotation tools, and the most font support, choices of colors and shading available.

Compatibility? As with any 1-2-3 product, it's no problem. Because Release 2.3 will read all of the files you've created on previous versions of 1-2-3, including files you've formatted using Allways™ and Impress.™ So you'll preserve all your work, as well as your training.

For more information about the new Release 2.3 or for upgrade details, call us today at **1-800-TRADE-UP, ext. 1110.**

What's New In Lotus 1-2-3 Release 2.3.

- A WYSIWYG graphical environment with live on-screen formatting
- Lotus Magellan viewer technology for fast file previewing, retrieving and linking...all without leaving your active worksheet
- More graph types, including 3D-effect graphs and graph annotation capabilities
- Auto Compress, for a trouble-free way of making larger worksheets print on single page
- Dialog Boxes for an easier, more interactive way of working
- Text-editing for easy on-sheet word processing, including automatic word wrap, even around graphs
- The Auditor for documenting or highlighting your spreadsheet logic
- Improved memory management for building larger worksheets up to 12 MB in size
- New printer drivers that support all leading laser and dot-matrix printers
- Context-sensitive Help and an interactive tutorial

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The new Lotus 1-2-3 for DOS

Lotus

parameters are set for efficient operation of the network. Though end users can see diagnostic information, they don't have access to security data.

The system assures security by assigning numeric security levels to users, groups, files, and directories. This security system lets you fine-tune access to resources in almost infinite detail, but it isn't easy to manage on a large-scale system. You can also limit the number of log-on attempts a user can make.

If you run into a snag, just consult *10NET*'s context-sensitive help. You will find help both in the menus and at the DOS command line. If you still have questions about the program, DCA offers users unlimited technical support on a toll-free line from 8:30 to 8:00, E.S.T.

Traditionally praised as a high-connectivity LAN, DCA's *10NET Plus* earned its reputation with its support of RS-232 bridging, SMB, NDIS, TCP/IP, 3270, and now 10BEUI. *10NET Plus* has proven itself a viable contender for small, medium, or large companies in need of a network operating system, or for companies with existing networks that need a network with specialized features.

WEB Network Operating System

by Sara Parker

WEB Network Operating System is a new contender in the peer-to-peer LAN arena. Released in July 1990 by WebCorp, *WEB* offers a hardware-independent solution for networking PCs. Targeted at small businesses and corporate workgroups, *WEB* offers simple installation, ease of use, and strong performance in a relatively inexpensive package. The menu interface was designed to allow end users to manage their own network operations. *WEB* also uses an innovative data compression scheme for Ethernet packets.

WebCorp offers an attractive pricing scheme. A 5-node package costs $495, a 15-node version $995, and a 30-node version $1,495. The Western Digital 16-bit adapters we used cost an additional $219 per node. The combined hardware/software price in a 10-node network amounts to $318 per node.

Although WebCorp sells its new DOS-based LAN directly as a software-only solution, you will also find *WEB* bundled with USIT, Everex Systems, and Gateway Communications adapters. If you are interested in a total solution, you can purchase any of these adapter cards and get *WEB* included with them.

WEB is targeted at small businesses and corporate workgroups. It offers simple installation, ease of use, and strong performance in an inexpensive package.

WEB runs on all network interface

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FACT FILE

***WEB Network Operating System,* Version 2.55**
WebCorp, 3000 Bridgeway, Sausalito, CA 94965; 415-331-1449.
List Price: 5-user version, $495; 15-user version, $995; 30-user version, $1,495.
Requires: 64K RAM in both client PC and nondedicated server, DOS 3.1 or later, appropriate ARCnet, Ethernet, or Token-Ring adapter.
In Short: A low-cost peer-to-peer LAN alternative that WebCorp packages only as software, *WEB* makes a good choice for small- to medium-size workgroups on virtually any type of existing hardware. Although the package might benefit from some tweaking, it offers generally speedy performance and an innovative data compression scheme for Ethernet packets that provides increased control for the end user. Keep an eye on this company.

CIRCLE 607 ON READER SERVICE CARD

cards that use *NetWare* drivers, including ARCnet and Token-Ring, because *WEB* also uses Novell's IPX protocol. WebCorp is in the midst of releasing gateways and APIs to allow resource-sharing between *NetWare* and *WEB*.

COMPRESSING ETHERNET PACKETS

The most innovative aspect of *WEB* is its use of data compression inside the Ethernet packets. *WEB* compresses the message portion of the packets before transmitting them, allowing for potentially phenomenal throughput when sending packets of maximum size. We found, however, that on the small blocks of data typical of DOS applications, the processing overhead added by the compression software is not worth the benefit.

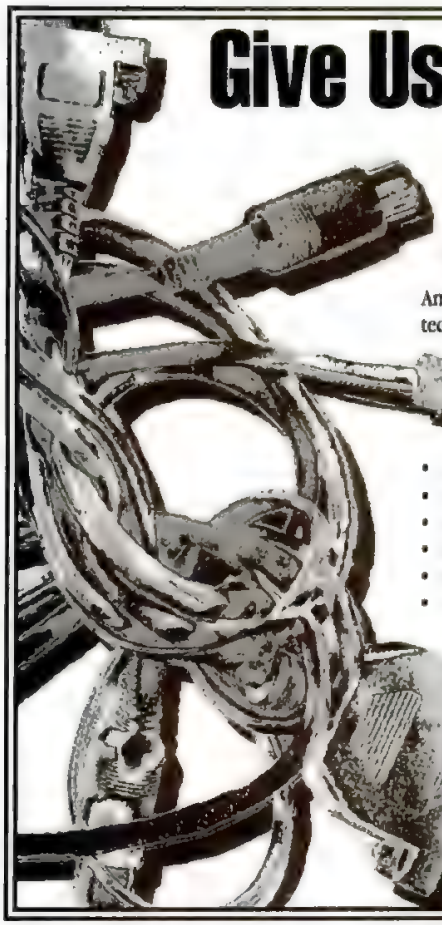
WEB performed well, but the average throughput results shown in our benchmark tests do not indicate the uneven results with different record sizes. The package had throughput rates of over 10 megabits per second on tests using 16K data requests, but fell back to less than a megabit per second when the tests used data requests of 512 bytes.

WebCorp certainly has a good idea with the compression technique; with a little added intelligence regarding which packets are compressed, its product will be a force to reckon with in the future. On our benchmark tests, *WEB* was one of the leading products. The program handled the simultaneous tasks of printing and heavy disk access very well.

WEB's most innovative aspect is its use of data compression inside the Ethernet packets.

EASY INSTALLATION

We found *WEB*'s software easy to install. The documentation leads you through the process, with on-line context-sensitive help always available. You can make the server dedicated or nondedicated, and configure workstations to do double duty as file and print servers or to act only as client PCs. The installation modifies the AUTO-



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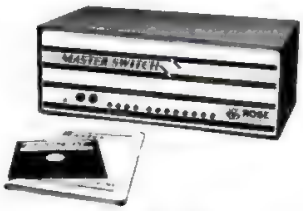

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Artisoft VPI is a set of simple, straightforward software routines which use Sounding Board to record and play digitized sound. VPI uses a structure called the Voice Control Block (VCB) — similar to an NCB or MCB in the NetBIOS — which contains pointers to blocks of data that can be used for PLAY and RECORD. Commands can be no-wait, so the control returns to the calling program immediately while VPI works in the background. When the VPI command completes, your POST routine is called.

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PC MAGAZINE EDITORS' CHOICE
May 29, 1990

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CIRCLE 254 ON READER SERVICE CARD

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PC Magazine says "Editors' Choice!" When reviewing 486/25 systems, they said "Only one machine stands out ... you could pay less for a 486 system, but not get the bonuses that are offered with the Elegance."†† In the February 12, 1990 issue, *PC Magazine* declared Elegance 486/33 Editors' Choice, saying the system was "a sure winner in its class."

Elegance 486/25i, Sept. 11, 1990
Elegance 486/33i, Feb 12, 1991

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†*InfoWorld*, July 30, 1990 ††*PC Magazine*, September 11, 1990

CIRCLE 198 ON READER SERVICE CARD

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PC MAGAZINE EDITORS' CHOICE
January 31, 1989
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CIRCLE 146 ON READER SERVICE CARD

EXEC.BAT file, after first asking for user approval. The software does not currently support remote-boot ROM.

WEB takes up only 64K of RAM on both the file server and the client PC, no matter which configuration you use. The operating system does not include a built-in memory manager, but you can use third-party memory managers if you need this capability. WebCorp bundles *HyperDisk*, a shareware disk-caching utility that you can configure when you set your defaults.

STATION MANAGER

The Station Manager is a menu-driven TSR that invokes the E-Note e-mail application, manages print jobs, accesses networked files and devices, and selects the default printer and serial device on both client stations and servers. The System Information Screen found in the Station Manager gives you information about your PC, adapter name, transmission and reception attempts, and error status.

The Station Manager nicely implements E-Note, *WEB*'s system for messages and electronic mail. After a pop-up window tells you that you have an incoming message, you can save the message to a file or forward it to another user. The station designated as the Post Office picks up mail for the off-line PCs and delivers it when the users come back on-line.

WEB offers very good security features for end users, since they can select the type of access to their resources granted to other network users. Through the Station Manager, end users can protect drives, directories, files, and devices by hiding them, marking them as read only, or restricting access to those users with passwords. The network administrator can override these abilities.

With *WEB*, the station that "owns" the printing device has complete control over all print jobs sent to it, regardless of who sent them. Since end users can hide or password-protect their peripheral devices, they decide who will have access to their printers. *WEB*'s printing was a little on the slow side.

With *WEB*, end users can control other users' access to their resources.

WebCorp offers free technical support to registered users on a toll line, weekdays from 8:00 to 5:00, P.S.T. WebCorp also offers an optional 900-number technical-support service.

WEB is a reliable, hardware-independent solution to low-cost LANs. It offers innovative aspects, like compression of Ethernet packets and user-controlled security. Expect to see interesting things from this company. ■

Sara Parker has experience in technical support and user training. She specializes in software systems. Kimberly Maxwell is a newspaper journalist and frequent contributor to PC Magazine.

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*Comparison based on a 386 with 4MB RAM.

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CIRCLE 228 ON READER SERVICE CARD

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data center (as we're now doing for several large customers) or we can take responsibility for selected areas:

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If you like, we can begin by analyzing your operation to see where, or if, we can help you. If you don't need us, we'll say so. But if we can save you money, we'll show you how, up front. We'll also put you in touch with similar customers so you can share their experience.

The idea is for IBM to lighten your IS burden, to free your resources so you can focus on your core business. After all, our core business *is* IS. We're already geared for just about any problem you're likely to face. So our economics of scale can mean economy for you, too.

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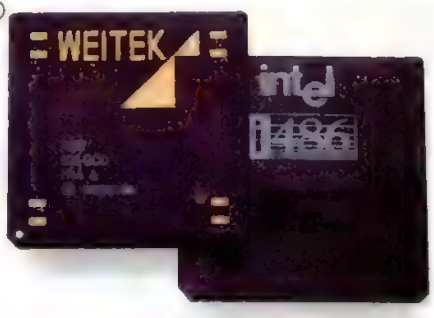
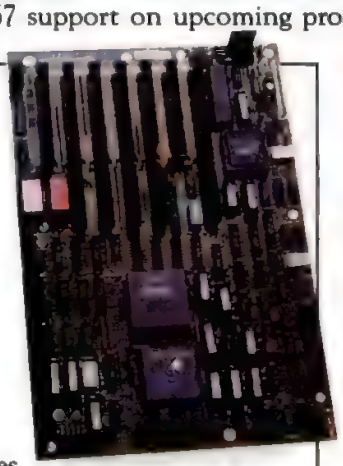


The 4167's 10 MFLOPS performance delivers 3X the speed of the 486!

The new Weitek 4167 coprocessor outperforms the 486 by 3 to 1 in numeric processing. Capable of 10 MFLOPS, the 4167 has sockets in some of the most sophisticated 486 systems on the market, including Compaq, Intel, Hewlett-Packard, and Microway. The 4167 is object-code compatible with the WEITEK 3167 FPU and Microway's mW3167-PS add-in card for the MicroChannel—offering easy access to a broad base of existing CAD/CAM, scientific and engineering applications like Mathematica, CADKEY, HOOPS and Microway's NDP compilers. And look for 4167 support on upcoming products from Autodesk!



Number Smasher®-486 converts your old AT or 386 into a powerful 486 workstation. In a review of 25 MHz 486 motherboards, Mike George of *Personal Workstation* magazine wrote, "Microway's Number Smasher-486 gives you top 486 numeric performance for the best price...Number Smasher's numeric performance exceeds that of all 25 MHz 486 systems we've tested to date." Running the Microway Benchmark Suite, the 4167-equipped Number Smasher-486 achieves 11.9 MegaWhetstones. The board features a Burst Bus™ memory interface that makes it stand out in numeric problems that involve large arrays. Burst cycle response in a 486 system is much more important than second level caches, which are usually too small to be of any use on the megabyte arrays found in real world problems.

The ideal solution for numerically or I/O intensive applications is Microway's new Number Smasher-486/33T workstation. Two configurations are available, each incorporating state-of-the-art power and cooling with 300 to 600 megabyte drives.

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486/25: Entry To 486 Power

by Bruce Brown

No longer the top dog, the 486/25 has become the best entry to high-powered computing at a reasonable price. PC Labs tests 32 EISA, ISA, and MCA systems.

Computers powered by 25-MHz 80486 CPUs may not be the absolute fastest you can buy today, but they're still the best-priced entry into 486 computing. To date, we have looked at 53 25-MHz ISA, EISA, and MCA bus systems (*PC Magazine*, September 11, 1990, and June 11, 1991); in this issue we cover 32 more.

There's plenty of appeal in this category. For one thing, you get the 486's most important advantages: a built-in 8K cache and math coprocessor (the latter being

IN THIS OVERVIEW

- American Mitac 4270F
- CUI Advantage 486
- IBM PS/2 Model 90XP 486 OJ9
- Industrial Data Systems Cache 486 25
- Insight 486-25
- International Inst. Blue Max Monolith 486/250E
- KRIS 48C-2
- KRIS 48E-2
- Master Cascade 48625
- Matrix Digital 486/25 ISA
- Matrix Digital 486/25 EISA
- Mega Impact 486-25
- Micro Express ME 486-ISA
- National Micro Systems Flash 486
- NCR Model 3341
- Novas OPTimum 486-25
- PC Brand 486/25 ISA
- Peregrine 425T
- Poly 12/486-25A
- Poly 486-25EISA
- Reason Square 4
- SAI 486/25 ISA
- Softworks Citus 486 TS 25i
- Tangent Model 425i
- Tangent Model 425e
- Tenex 486 Power Column
- Touche 5550T/486-25
- Touche 5550T/486-25E
- Treasure Chest TC 486-25
- Ultra-Max 486-25
- Unisys PW2 800/486-25A
- Zeos 486-25C

PHOTOGRAPHY THOM O'CONNOR

particularly valuable in engineering and CAD applications). In testing, a 25-MHz 80486 processor performs about 10 to 15 percent faster than a 33-MHz 386.

The price differential is also favorable, for now. Systems based on the 486/25 can cost anywhere from $500 to $1,000 less than identically configured 33-MHz 486s. They're also only about 15 to 25 percent (often only $400 or $500) more expensive than 386/33s. Judging by the 61 systems we compared in this issue and last, you can expect to pay about $5,500 to $7,000 for a fully configured EISA 486/25 and about $4,000 to $5,000 for an ISA system.

But those prices are bound to change—especially once Intel releases its 20-MHz 486SX chip, essentially a slower 486 without a coprocessor that will sell for about $260. Already, the difference in price between 25-MHz and 33-MHz 80486 chips is just $79 to $588 for the 25-MHz and $667 for the 33-MHz. Unless you need to buy computers today and are sure the 25-MHz 486 gives you the right performance at the right price, you may want to hold off for a few months.

ROUGH TIMES AHEAD

Unit sales of 486s are still low. Industrial Data Corp. of Framingham, Massachusetts, predicts that in 1991, 486s will comprise roughly 5 percent of the unit sales for domestic Intel CPU systems. Computer Intelligence, a La Jolla, California, market research firm, reports that for computer sales of all processor types in this country, less than 1 percent of planned purchases and 1 percent of current retail sales are 486s.

Sales of 486-based systems are sure to increase dramatically during the next few years, especially as their use in file servers and CAD machines grows. But the role of the 25-MHz 486 is still in question. Most observers agree that those willing to pay the premium for a 486 are performance- and not price-driven and will skip the 25-MHz to buy 33-MHz units today and 50-MHz units when they're available. The price-sensitive buyers, they predict, will turn to the 486SX (see "486SX: One Step Forward, Two Steps Back" sidebar in "486/25: Newly Affordable Power," *PC Magazine*, June 11, 1991).

Some vendors, when queried about this issue, suggested that there's a customer at every price/performance point and that the 25-MHz 486 is a reasonable step in today's market. Others expect the 25-MHz 486 to go the way of the 16-MHz

25-MHz 486-BASED PCs: INDEX

Model	Bus	List price (standard configuration)	80486 Instruction Mix test score (seconds)	*PC Magazine* review (issue and page number)
				Sept. 11, 1990
ACMA 486/25	ISA	$5,499	1.42	101
Amax 486/25 Power Station	ISA	$5,499	1.46	101
AST Premium 486/25	ISA	$10,944	1.49	103
Blackship 486/25	ISA	$5,636	1.46	104
Club Hawk II	ISA	$5,795	1.46	107
CompuAdd 425	ISA	$5,670	1.47	111
Computer Market Place Ultra 486-25	ISA	$4,497	1.46	112
CSS MaxSys 486T/25	ISA	$9,892	1.48	125
Dataworld Data 486-25	ISA	$6,265	1.47	130
Destiny 486/25	ISA	$8,945	1.46	159
Everex Step 486/25	ISA	$10,525	1.46	134
Gateway 2000 486-25	ISA	$4,970	1.46	136
Micro Express ME 486-25	ISA	$5,570	1.46	138
Micro Telesis MT 486DX	ISA	$4,999	1.50	140
Mitsuba 486-25	ISA	$8,525	1.46	151
Northgate Elegance 486/25	ISA	$5,830	1.45	153
Osicom Executive 486/25	ISA	$7,000	1.57	156
Polywell 486/25	ISA	$6,150	1.46	159
SAI 486/25 ISA	ISA	$5,495	1.47	160
Swan 486/25	ISA	$6,024	1.46	164
Syntrex 486/25C	ISA	$11,119	1.50	167
Transource Venxion 486	ISA	$5,295	1.46	168
Tri-Star 486/25	ISA	$5,555	1.46	170
Twinhead Superset 600/425	ISA	$6,995	1.47	172
				June 26, 1990
ALR PowerCache 4	MCA	$14,989	1.46	122
ALR PowerCache 4e	EISA	$14,989	1.42	122
				June 11, 1991
Acer 1170	ISA	$7,564	1.44	162
Acer 1200	EISA	$10,064	1.45	162
ACMA 486/25I	ISA	$4,195	1.44	168
ACMA 486/25E	EISA	$6,595	1.45	168
ALR BusinessVEISA	EISA	$9,669	1.46	178
AGI 4100A	ISA	$6,995	1.44	179
Amax 486 EISAmax	EISA	$6,910	1.48	184
American Research Corp. Skyscraper 486/25c	ISA	$3,515	1.48	186
Apricot Qi 900	MCA	$8,895	1.61	208
Austin Winstation 486/25e	EISA	$6,995	1.45	213
Blue Star 486/25c	ISA	$3,799	1.49	217
Boss 486 Model 4625	ISA	$5,895	1.48	218
Bus 486-25	ISA	$3,799	1.45	224
C² 486-25	ISA	$4,200	1.48	228
Cheetah Gold 425	ISA	$10,489	1.45	229
Club 486 Hawk II	ISA	$3,995	1.44	234
Computer Market Place Ultra 486	ISA	$3,976	1.48	236
Copam 485/25 EISA	EISA	$8,779	1.45	239
CSS MaxSys 486 MTE/25	EISA	$10,962	1.48	246
Dataworld Data 486-25	ISA	$4,545	1.45	248
Dell System 425TE	EISA	$7,818	1.45	251
DTK Feat-2502	ISA	$5,514	1.44	254
Dynamic Decisions Dynex 486 ISA	ISA	$4,730	1.45	255
Dynamic Decisions Dynex 486E	EISA	$5,950	1.46	255
Dyna Work Master 486 25 Cache	ISA	$4,839	1.48	260
Dyna Work Master 486 25 Cache EISA	EISA	$6,689	1.58	260
EPS 486/25 Tower	ISA	$4,195	1.48	265
Hewlett-Packard HP Vectra 486	EISA	$13,395	1.49	265
HiQ 425i	ISA	$3,699	1.44	270

—Editors' Choice

and 20-MHz 386DX chips fairly quickly.

Regardless of its fate, however, the 486/25 still gets you into the 486 world at the best price to date. The 32 systems reviewed in this issue offer a good selection of bus types, cases, and component mixes suitable for applications from file servers to small-footprint power user machines.

REVIEW CRITERIA

As was the case in the first half of this story, the 486/25s in this review all came configured with 8MB of RAM, an external processor RAM cache if available, a 200MB to 300MB hard disk, at least one high-density floppy disk drive, VGA or Super VGA video, color monitor, one parallel and two serial ports, and DOS 4.01 (or 3.3). In this group, we tested 8 EISA, 22 ISA, and 2 MCA systems. In addition, we report the results for the first 29 systems we tested.

We allowed manufacturers of EISA systems to send their machines equipped with caching, bus-mastering disk control-

EDITORS' CHOICE

- **Tangent Model 425e**
- **Zeos 486-25C**

The most serious contenders in the 486 arena have turned to EISA, and at the 486 level, EISA's potential is probably worth the investment. Our Editors' Choice winners, Zeos and Tangent, unleash EISA's power without bleeding the buyer.

It's harder to distinguish among the plethora of ISA machines. While many vendors are producing good, moderately priced systems, none stands out the way the Editors' Choice EISA systems do. Tangent (honorable mention), PC Brand, Tenex, Treasure Chest, and Micro Express, however, deserve credit for selling ISA systems with FCC Class B certification for less than $5,000, though these systems fall short of some of the others reviewed here.

On the other end of the spectrum, the IBM PS/2 Model 90 and the Unisys PW2 800/486-25A systems deserve honorable mention for their ruggedness, though they're among the most expensive machines in this roundup.

EISA AND CACHE

Zeos and Tangent share this award with the Dell 425TE (*PC Magazine*, June 11, 1991) and the ISA-bus Northgate Elegance 486/25 (*PC Magazine*, September 1990). In short, the Mylex motherboard is a winner—especially in conjunction with the superfast Mylex disk controller (thanks to its on-board processor and cache).

The Zeos 486-25C wins for its price/performance ratio. In our standard configuration (8MB RAM, a 200MB hard disk, one floppy disk drive, VGA or Super VGA video, one parallel and two serial ports, and DOS 4.01), the Zeos sells for $5,890 and comes with extras such as a 1,024-by-768 graphics monitor, *Windows* 3.0, and a mouse. And with its 450-watt power supply, this system can fire up as many drives as you need.

Tangent's Model 425e includes an Edsun chip (best known for its superior line-smoothing ability) in its excellent display subsystem. The $6,245 system (with a 207MB hard disk and the Mylex caching disk controller) comes in a case similar to Zeos's, though Zeos squeezes a bracket for two extra drive bays into its 486-25C.

One last note on EISA systems: International Instrumentation deserves some credit for making the most dramatic improvement. Since our last look at III's Blue Max Monolith series (*PC Magazine*, February 12, 1991), the company has dropped its prices by an astounding 40 percent and has added on-site service, while maintaining its use of quality components. At $4,916 for a roomy EISA tower that performs admirably, this system is worth a look.

There is such a thing as affordable 486 power. PC Brand, Micro Express, Tenex, and Treasure Chest sell Class B–certified systems for less than $5,000. The Tangent Model 425i will probably have joined that group by the time you read this review; it was in its final approval stages at press time.

Assuming it gets Class B certification (highly likely), the Tangent Model 425i is probably your best ISA purchase. Low price ($4,084 with a 207MB hard disk), innovative video (with the Sigma card's Targa file compatibility and 1,024-by-768 noninterlaced graphics support), and a solid service policy (including TRW on-site and a two-year motherboard warranty) all come standard.

Each of the remaining four systems has its compromises. The Tenex and Treasure Chest systems are virtually identical to the DTK system reviewed in *PC Magazine*, June 11, 1990; none exhibited particularly good test scores despite their quality components. The Micro Express system lacks an on-site service option. PC Brand's 486/25 ISA contains familiar (if not top-performing) components, though it lacks user-oriented documentation. To its credit, PC Brand has contracted with TRW for on-site repairs and offers at least some limited coverage beyond the standard one-year warranty.

FOR THE CORPORATE SET...

The Unisys PW2 800/486-25A deserves honorable mention for its ruggedness. Like Hewlett-Packard, Unisys excels more for its reliability and in its vast array of networking options than its performance in a DOS environment. It's unlikely that either machine would justify a $14,000 expenditure as a desktop. But for use as a file server, either machine would be a solid choice. With Unix options, a wide range of network possibilities (including Novell certification), and a rich, multilevel service plan, this ISA system is a class act.

In the same vein, IBM's PS/2 Model 90 could be the most expensive desktop system you'll ever love. Even after a 25 percent dealer discount, this small-footprint system costs nearly $13,000—and comes with only 160MB of hard disk storage. Nevertheless, IBM's focus on XGA video makes this a superior workstation for CAD users.

lers. Since we generally test noncaching disk controllers in the ISA environment, the cache gave the EISA systems an advantage in the disk test. Keep that in mind when you see the disparity in DOS File Access benchmark test scores. (You can greatly improve your own disk performance by using any of the software disk caching packages available with many of these systems at a considerable savings over hardware caches. See the sidebar "Software Disk Cache: The Price/Performance Edge.")

Whether you need the math coprocessor advantage of the 486 chip today depends on whether your applications can take advantage of it. And having an onboard cache will always be a benefit. But, above all, if you're contemplating a high-end system, the shrinking price differential between platforms should steer you toward the 486/25.

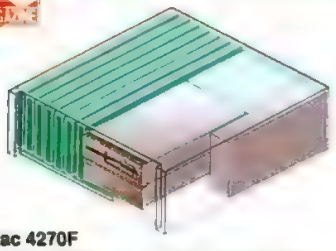
AMERICAN MITAC CORP.

Mitac 4270F

by M. David Stone

The Mitac 4270F, from American Mitac, has the distinction of being the first EISA system to come through PC Magazine Labs in a small-footprint case. Alas, the combination seems oxymoronic, given that the EISA bus currently has more promise for network servers than for desktop systems. And there are significant compromises that come from cramming a

FACT FILE



Mitac 4270F
American Mitac Corp., 410 E. Plumeria Dr., San Jose, CA 95134; 800-648-2287, 408-432-1160.
List price (tested configuration): $10,843.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Quantum 13-ms. 426.5MB SCSI; Mylex controller, 1MB cache; 1.2MB floppy disk drive.
Display: American Mitac Super VGA adapter, American Mitac 14-inch monitor.
Software: DOS 4.01.

CIRCLE 400 ON READER SERVICE CARD

BANG FOR THE BUCK: A New Way to Look at PCs

by Bill Machrone

It's not easy choosing among PCs. We're constantly looking for better ways to analyze and present our findings. In addition to our time-honored benchmark tests and hands-on observations from our reviewers, we're introducing a new graph, the Bang for the Buck chart. In it, you'll find an analysis of performance results and features compared with price.

The Bang for the Buck chart tells a compelling story of how much machine you're getting for your money. Of course, price, performance, and features are not the only determinants of a machine's desirability. A vendor's reputation, service, and support; your company's purchasing policies; and value added by the channel of distribution all play a part. Then, too, the computer has to fit your needs in other ways: footprint, ergonomics, the kind of keyboard and monitor included, and some intangibles such as the machine's style and image. But the chart is one more weapon in your arsenal of techniques for selecting the best machine.

RAW DATA

We started with our four key benchmark tests: processor speed, memory speed, DOS file access speed, and video speed. These scores make up the core of a machine's performance. Then we added six more pieces of data: the amount of RAM, the size of the hard disk, the amount of VGA RAM, the number of free slots, and the number of drive bays. In the last, an "extras" category, we gave points for miscellaneous bundled items, such as a mouse and *Windows* or utility software. Vendors were also given points in the extras category for having FCC Class B certification, on-site service, or standard warranties that extend beyond one year.

We took care not to include categories that track or duplicate one another. For instance, power supply wattage is usually proportional to the size of the case and the number of drive bays; therefore, we left wattage out of our calculations.

To derive our "Bang" figure (the chart's performance/features, or *x*-axis) from the raw data, we inverted the benchmark test results to create numbers that grow larger as performance increases; then we assigned a weighting factor to each category. We used the weighting factor as a means for adjusting the relative importance of each feature or performance category. Overall, the four benchmark test scores accounted for a bit more than half of the total, and the remaining six categories made up the difference.

We made one adjustment to the "Buck" (price, or *y*-axis) figure, as well: The price as tested is discounted a flat 25 percent for all dealer-distributed machines in order to make them more comparable in the real world with their direct-marketed counterparts. We may provoke the ire of value-added resellers and others who don't discount as heavily, but our formal and informal surveys tell us that it's a workable number.

While the chart in this article covers only 25-MHz 486s, we put machines of every processor type and power level through the same calculations in order to verify our results. After you've used a wide variety of machines, you get a strong sense of their pecking order. The chart reflects these real-world observations faithfully.

Even with the weightings, some features or benchmark test results stand out. In the case of these 486/25 machines, the ones equipped with caching disk controllers had the best ratings. Of course, you pay more, but we've highlighted the results anyway.

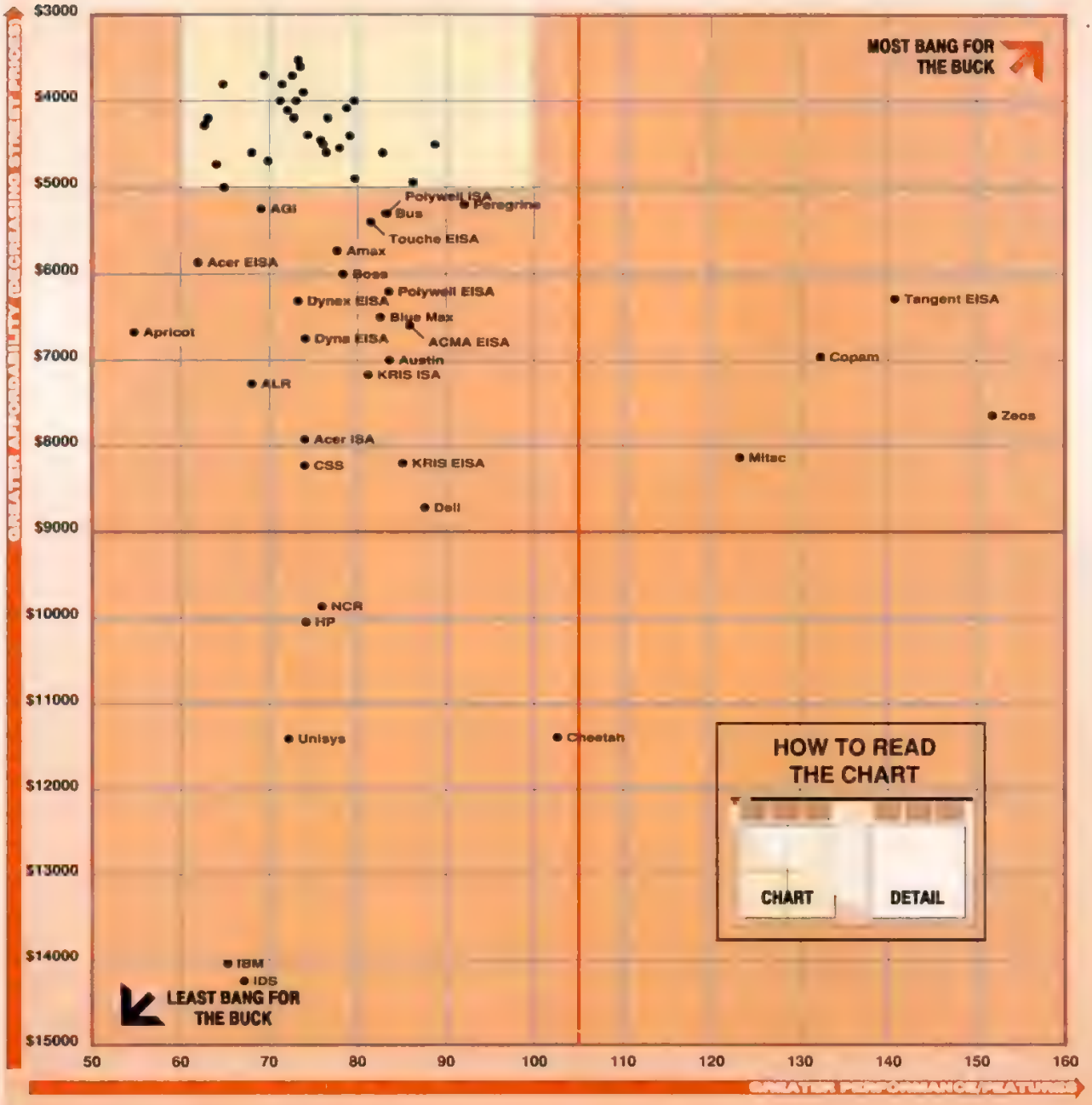
Finally, for those who are curious about the underlying calculations, we've made the worksheet we used available on PC MagNet. Look for 12BANG.WK1 in Software Library on the Editorial Forum. We welcome your comments. ■

PRICE-PERFORMANCE INDEX: 25-MHz 486s

Five 486/25 systems with cached, coprocessed disk controllers scored highest on performance. Lower ratings of famous names IBM, HP, Unisys, and NCR reflect high prices. More than half the machines are in a tight cluster, reflecting similar price/performance.

These 61 486/25 ISA, EISA, and MCA systems fall into three broad bang-for-the-buck categories: coprocessed, disk-cached high performers (5); costly and conservative brand names (5); and systems that trade some performance or features for competitive prices (51). Affordability, measured by decreasing street (not list) price, is charted on the *y*-axis. The sum of ten performance and features items are charted on the *x*-axis.

Bang-for-the-buck leaders Zeos, Tangent, Copam, American Mitac (all in the upper-right quadrant) and Cheetah use caching, coprocessing disk controllers that produce disk scores many times better than the average 486/25. Don't expect multiples of performance or value compared with other systems, though, because disk performance is one of just ten components we consider. The others: processor, memory, and video performance, installed RAM, hard disk capacity, VGA RAM, free slots, drive bays, and extras (including free software, mouse, on-site service, FCC Class B certification, and extended warranty policy).

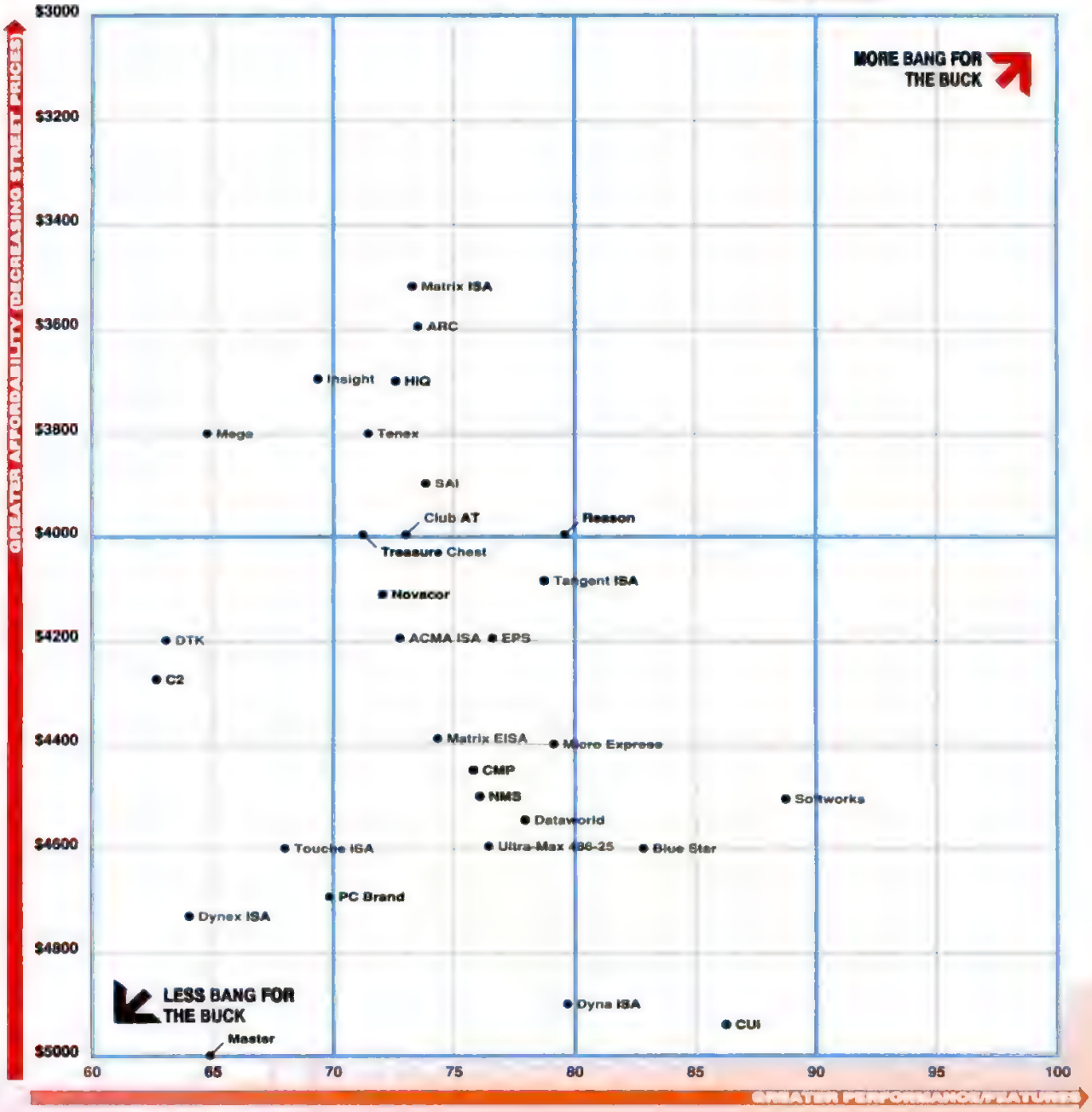


First-tier vendors IBM, Hewlett-Packard, NCR, and Unisys plus specialty maker IDS fell into the highest price category (the lower left-hand corner) without gaining as many performance/features points. Their best assets include ruggedness, reliability, name recognition—intangibles that can't be factored into this chart—and a wide variety of networking options. You'll find them in the lower-left quadrant, which represents less bang for the buck.

Among the remaining 51 machines, 30 fall into the largest group (in the light beige shaded area). Because these 30 are so tightly clustered, they're charted in the enlarged square on this page. In general, EISA systems have higher price and performance/features scores (a by-product of their caching disk controllers). The ISA systems, often at the top of the cluster, had lower prices, but their uncached controllers gave many of these systems lower performance scores. These scores would rise with the addition of software caches (not tested), an important, inexpensive performance booster for DOS PCs.

DATA POINTS DECODED

Ten data points—the four benchmark test scores, installed RAM, disk capacity, VGA RAM, free slots, drive bays, and extras (free software, mouse, on-site service, FCC Class B certification, and extended warranty policy)—make up the *x*-axis score. A set of weighting factors has been applied to the raw numbers used to calculate this score; you can find this data in the Software Library on PC Magnet's Editorial Forum on CompuServe under 12BANG.WK1. Location on the price axis is based on each system's cost as tested. Dealer-sold systems are discounted 25 percent to account for likely street price. Systems are rated as standalone PCs, not as file servers.



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SYSTEM CONFIGURATION AND PERFORMANCE: A GUIDE TO THE GRAPHICS

BENCHMARK TESTS

The Bars
Each colored bar represents the **range** of all 486/25 test scores, from fastest to slowest. *The longer the bar, the wider the range.* If the best score is more than twice as fast as average, an upward-pointing arrow will appear atop the colored bar.

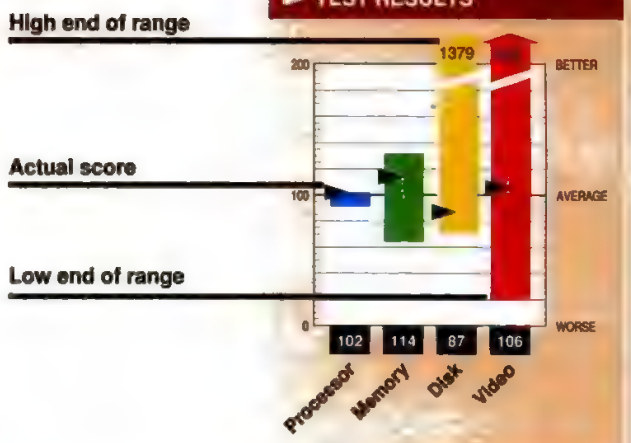
A black arrow on each bar represents the given system's **position** within the range. *The higher the arrow, the better the performance.* If a system performs more than twice as fast as average, the black arrow appears at the top of the bar, pointing upwards.

The Boxes
A **normalized score** appears in the box below each colored bar. To derive this figure, we calculated the average score for all 486/25s reviewed in *PC Magazine*, September 11, 1990, and June 11, 1991, as well as those here. We then divided this average by the score of each machine in turn and multiplied by 100.

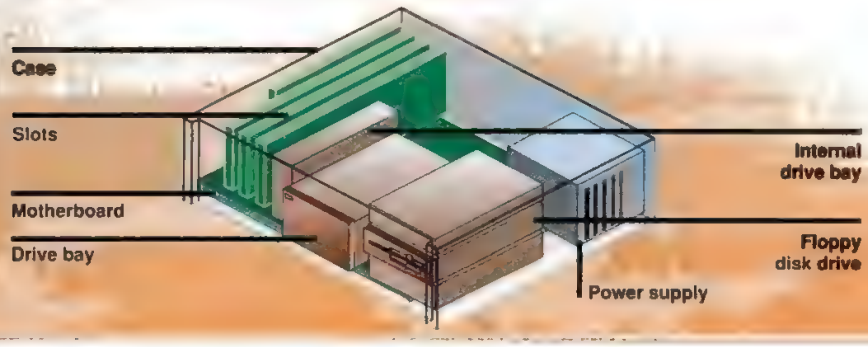
Thus the average score is 100; a number greater than 200 indicates that a system performed the test in less than half the average time; a number smaller than 50 indicates that the system took more than twice as long to complete the test.

A table of **actual scores** accompanies the three-dimensional bar charts.

TEST RESULTS



INTERIOR CONFIGURATION DIAGRAM



Case Options include desktop, tower, mini-tower, small-footprint, and slimline.

Slots The number and length of cards represent the number and length of slots on the motherboard.

Drive bay A hard disk face plate indicates external access to a bay. Options include full-height, half-height, third-height, and 3.5-inch.

Floppy disk drive A face plate indicates that either a 1.44MB or 1.2MB floppy disk drive was installed in our tested system.

full-size board into a 6.3- by 15- by 16.8-inch (HWD) case.

American Mitac couldn't supply *PC Magazine*'s standard configuration because the smallest drive that the unit ships with is a whopping 426.5MB. The price for the unit's closest match to our standard configuration is $10,843, with 8MB RAM, 128K cache, a 426.5MB hard disk, one 1.2MB floppy disk drive, and a VGA subsystem. Note that the VGA subsystem as tested included a Super VGA board but was limited by the VGA monitor.

Certainly the most obvious compromise of the small-footprint case is a scarcity of drive bays. The unit offers two accessible half-height bays, one accessible 3.5-inch bay, and one internal 3.5-inch bay for a grand total of four bays. The company makes up for this bay shortage somewhat by supplying only high-capacity hard disks, which range from 426.5MB on up to 1.2GB. But the fact remains that having only four bays limits expansion possibilities. Note that the company has no other choices for the case.

OUR CONTRIBUTORS

Bruce Brown, Bill O'Brien, and **M. David Stone** are contributing editors of *PC Magazine*.

Mario Baldasserini is junior systems support specialist of PC Magazine Labs.

Kellyn S. Betts, Henry Fersko-Weiss, Patrick Honan, Edward Perratore, and **John R. Quain** are New York–based free-lance writers who contribute frequently to *PC Magazine*.

Greg Pastrick, a Boston-based author, is a frequent contributor to *PC Magazine*.

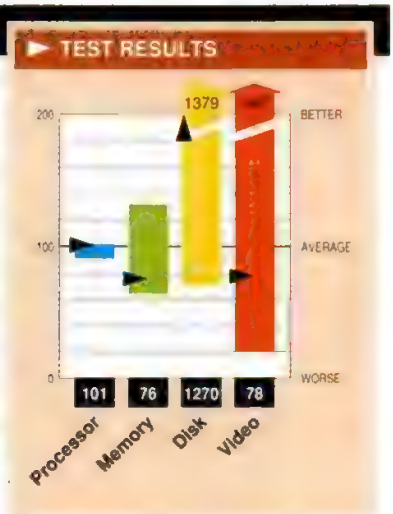
John Blackford is senior technical editor of *PC Sources*.

COMPROMISE

Another compromise forced by the physical design is that the inside of the box is as crowded as a subway during rush hour. As a measure of just how crowded that can be, the 4270F has nine expansion slots on the motherboard—including one dedicated 32-bit memory slot—but only six are accessible. The power supply covers two slots, and the power cables block a third. Also note that the coprocessor socket is under the drive bays. That means you have to remove the drives to get at the socket, making an upgrade to a Weitek coprocessor time-consuming.

Except for memory, all the key motherboard components are on the Mitac motherboard. In addition to the 80486 and the Weitek socket, you'll find the Intel

MITAC 4270F



In Short: The Mitac 4270F pushed the limits on its disk score but fell short on our video test. A Mylex bus-mastering caching disk controller with an on-board processor helped this system produce its top-tier disk score. The small-footprint design seems a limiting choice for the 486 environment unless space is really at a premium. Look elsewhere for bargains.

chip set, Phoenix BIOS, and 128K of 25-nanosecond processor RAM cache. System memory sits on a proprietary board that plugs into the dedicated memory slot. The board itself has 16 SIMM sockets that can be filled up to 64MB using 4MB SIMMs, or up to 16MB with 1MB SIMMS. Our test system had eight 1MB SIMMs installed.

> The inside of the Mitac 4270F is as crowded as a subway during rush hour.

MIXED PERFORMANCE

The five accessible expansion slots leave more room for growth than you might expect, with three slots still available on our test system. Most of the empty slots are courtesy of the Mitac multifunction I/O board, which contains VGA video, floppy disk controller, and parallel and serial ports on a single card. The video can give you 800-by-600 resolution, or interlaced 1,024-by-768 resolution with additional RAM. But it also turned in significantly lower-than-average performance on our video test. If you choose to replace the video with a faster or higher-resolution card, you'll be down to just two slots.

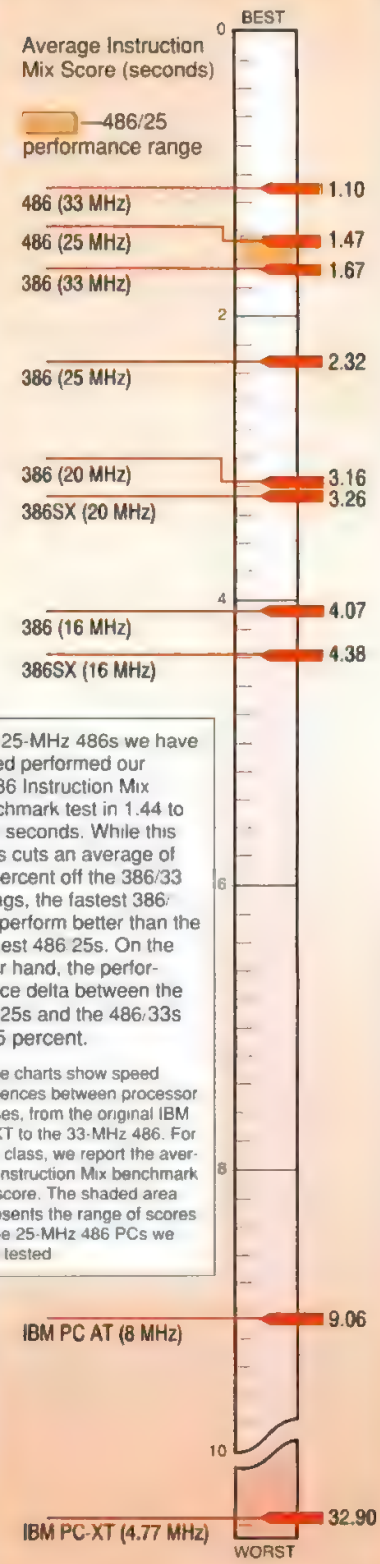
The only other card in the test system was a Mylex caching controller with 1MB of cache RAM. On our DOS File Access tests, this controller, which can support up to 16MB of cache, yielded sterling performance in combination with Quantum's 13-millisecond 426.5MB hard disk.

Processor speed, as measured by the 80486 instruction mix test, was another area where the unit's performance is clearly excellent, scoring at the high end of the norm. Unfortunately, the unit's Conventional Memory test results were somewhat disappointing. In a group of systems that showed little difference in conventional memory performance, the American Mitac unit was one of the few that actually fell below the norm. All told, however, its excellent disk performance makes up for most other shortcomings.

American Mitac's warranty and support policies are a strong plus for the system. The price includes a one-year warranty, complete with on-site service supplied by Bell Atlantic. Toll-free phone support is available from 7:30 to 5:30 P.S.T., Monday through Friday.

The entire Mitac line is high priced. The cost of a similarly equipped 386/33 ISA system, for example, is $8,360. More interesting, perhaps, is the company's 486/33 EISA. A similarly equipped 486/33 is priced at a hefty $12,843, but that includes

PROCESSOR PERFORMANCE COMPARED



The 25-MHz 486s we have tested performed our 80486 Instruction Mix benchmark test in 1.44 to 1.61 seconds. While this class cuts an average of 12 percent off the 386/33 timings, the fastest 386/33s perform better than the slowest 486/25s. On the other hand, the performance delta between the 486/25s and the 486/33s is 25 percent.

These charts show speed differences between processor classes, from the original IBM PC-XT to the 33-MHz 486. For each class, we report the average Instruction Mix benchmark test score. The shaded area represents the range of scores for the 25-MHz 486 PCs we have tested

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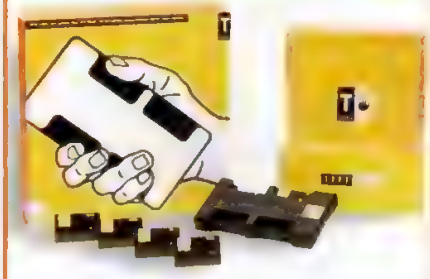

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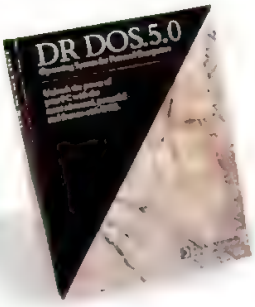

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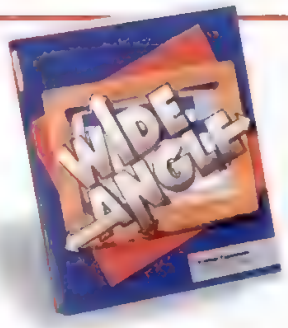

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9628 ▣ Headroom 2.0 . . . . . 65.

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2323 ▣ HyperACCESS/5 2.0 *(DOS & OS/2)* . . . 115.

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6222 ▣ Resume Maker 1.3 . . . . . 29.

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5653 ☐ 1-2-3 2.2 . . . . . 349.
5134 ▣ Magellan 2.0 . . . . . 109.
4131 ▣ Agenda 2.0 . . . . . 299.

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Microcom ... NCP
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6234 ☐ CarbonCopy Plus 5.2 . . . . . 119.

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7010 ☐ Windows 3.0 . . . . . 99.
7388 ▣ Project 1.0 for Windows . . . . . 459.
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6572 ▣ WealthBuilder 1.1 . . . . . 99.

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Roykore ... NCP
8162 ▣ ABC Flowcharter 1.1 . . . 189

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5799 ▣ Ami Pro 1.2 . . . 309

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9490 ▣Harvard GeoGraphics ..... 269.
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6397 ▣The Norton Backup 1.2 ..... 105.
3146 ▣The Norton Utilities 5.0 ..... 119.
3425 ☐Q&A 3.0 ..... 239.
7999 ▣Norton Anti-Virus 1.0 ..... 89.
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6564 ☐Software Bridge 5.0 ..... 79.
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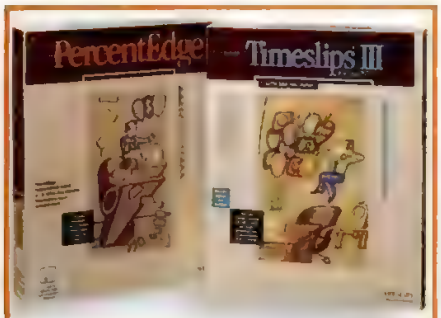
6994 ☐PercentEdge 1.0 ..... 69.
Timeworks ... NCP
6253 ▣Publish-It! 1.1 ..... 139.



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6685 ▣DrawPerfect 1.1 ..... 279.
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6791 ☐WordStar Prof. 6.0 ..... 219.
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8886 ▣SimEarth ..... 45.
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4534 ▣Mavis Beacon Teaches Typing *(CP)* ... 35.
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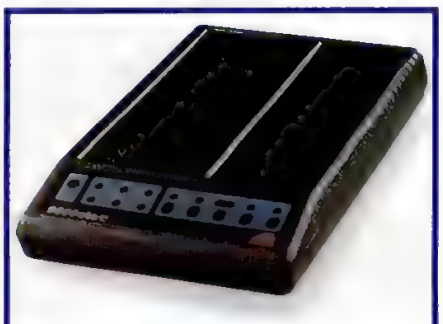

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7106 520ES *(stand-by power source)* ..... 329.
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8994 2400 Baud External Modem *(V.42 bis)* . . 209.
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9894 T1200XE Laptop *(40 Meg)* ..... call
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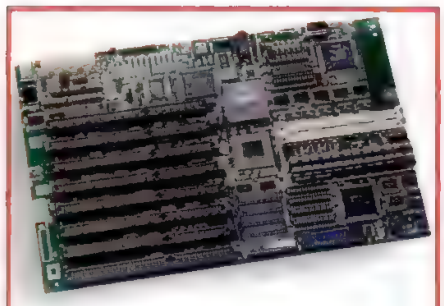

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3943 DC 2000 Tape Cartridge ..... 20.
6065 DC 2080 Tape Cartridge ..... 25.
3944 DC 600 Tape Cartridge ..... 29.
5679 DC 6150 Tape Cartridge ..... 29.

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a tower case and a 300-watt power supply, putting it firmly in server territory for both price and physical design.

As for the 4270F itself, the small-footprint design seems of questionable worth, especially at $10,843. There is no denying that you get a power user's system in this small-footprint box, but the limits on expandibility—and EISA's limited value outside of serverdom—make it hard to recommend at this price.

CUI

CUI Advantage 486

by John R. Quain

People who can't afford a large down payment but long for the space of a Victorian mansion will be drawn to the expansive case, sturdy performance, and reasonable cost per square foot of CUI's Advantage 486.

With a 210MB hard disk and one floppy disk drive more than is required by our standard configuration, better than run-of-the-mill performance, and a super tower case, the CUI Advantage 486 ISA system's $5,730 list price is quite reasonable. Our system came with a 366MB hard disk installed, which boosted the price to $6,585. CUI also bundles *Windows* 3.0 and a Z-Nix SuperMouse free with every system.

Based on a Free Technology motherboard that CUI says it has been using for a year without incident, the system has an Intel chip set, along with an AMI BIOS and a 256K external processor RAM cache. The system comes with 8MB of RAM on the motherboard, and you can add up to 16MB of RAM in 1MB SIMM increments. However, this motherboard's chip set will not address 4MB SIMMs, a limitation if you're considering specialized LAN applications that can benefit from additional memory. For CAD and desktop publishing workstations, though, there's room to plug in a Weitek 4167 coprocessor.

No PC in our roundup ran faster than the CUI Advantage in PC Magazine Labs' processor Instruction Mix test, although many ran just as fast. The CUI Advantage 486 was near the top of the heap on PC Labs' Conventional Memory tests as well, owing in part to its 70-nanosecond DRAMs. The Fujitsu SCSI hard disk's DOS File Access times were better than average, aided by the cache-less Bus Tek controller. Furthermore, the video subsystem turned in speeds that were faster than average.

BIG CASE, TINY KEYBOARD

One of the big features—the biggest in fact—of the CUI Advantage 486 is its monstrous case. Resting on four locking wheels, it's the same Herculean box used by the Touche and KRIS systems—with a swing-out front door as well as a hinged side panel and three ventilation fans (two front intakes and one rear exhaust). The chassis has both case and keyboard locks. However, the power button is awkwardly positioned on the back of the machine.

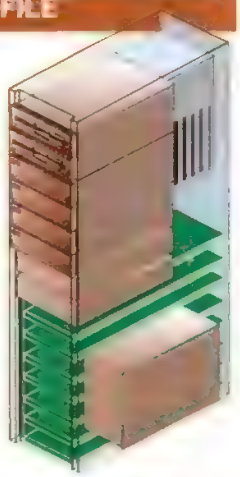
Inside the case are a total of eight full-size expansion slots, but only seven mounting brackets for full-length cards. With accommodations for four accessible and four inaccessible half-height drives, plus an additional full-height internal drive, most users ought to feel comfortable about future expansion requirements. A 375-watt power supply that comes standard in the machine means that power depletion should not be a problem.

One ironic aspect of CUI's oversized system is its tiny NTC keyboard—the same loose-keyed one in use on Zeos systems. The 14-inch Relisys monitor is capable of noninterlaced 1,024-by-768 resolution. It can accept separate BNC connectors.

If you're attracted by the Advantage 486's packaging but want the top-of-the-line 33-MHz 486 ISA, it will cost you $7,135. That's still a bargain, considering all the space you get inside the unit. And CUI sells through dealers, so you should be able to do better than the list price.

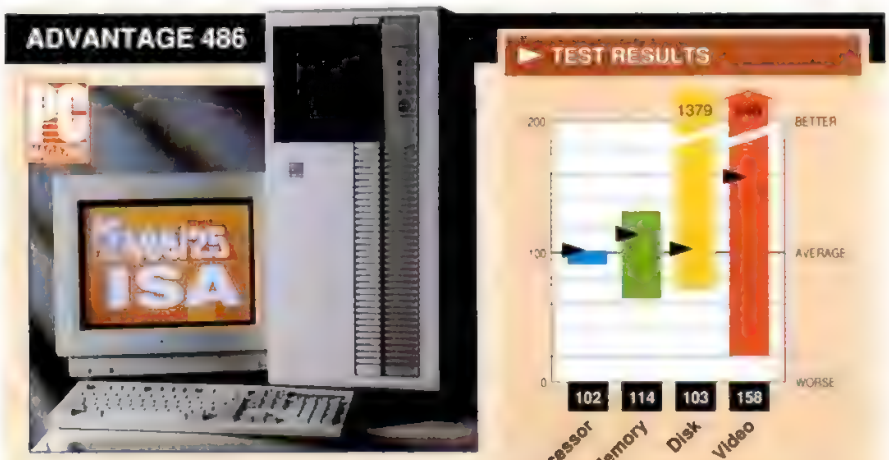
All this combined with CUI's toll-free tech support line, one-year parts-and-labor coverage, and the company's plans to institute on-site service (currently you must return the system to the dealer if you have problems) make this a system worth your attention.

FACT FILE



CUI Advantage 486
CUI, 1680 Civic Center Dr., #101, Santa Clara, CA 95050; 800-458-6686, 408-241-9170.
List price (tested configuration): $6,585.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: Fujitsu 16-ms. 366MB SCSI, Bustek controller, 1.2MB and 1.44MB floppy disk drives.
Display: Diamond Speedstar 1,024 by 768 adapter with 1MB RAM, Relisys 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

CIRCLE 401 ON READER SERVICE CARD



In Short: A good performer all around, this super-tower ISA system ran with the leaders on both processor and memory tests. The 1MB Diamond SpeedSTAR VGA adapter, with its Tseng Laboratories chip set, performed well above the norm, making the CUI Advantage 486 worth the $6,585—especially if you need an oversize case, expandability, and security.

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CIRCLE 335 ON READER SERVICE CARD

IBM CORP.

IBM PS/2 Model 90XP 486 OJ9

by Bruce Brown

Like the PS/2 70 series, IBM's PS/2 Model 90 comes in a sturdy, simple-to-disassemble FCC Class B case. And, like the 70, this 25-MHz 486 is easy to love despite its moderate performance and expansion characteristics. But it's love with a price.

In standard configuration the PS/2 90 costs a whopping $17,290, and that's with a 160MB hard disk. Other standard system components include a single 1.44MB floppy disk drive, 256K processor RAM cache, built-in XGA video circuitry with 512K of video RAM, and a 14-inch XGA color display.

Our test system, priced at $18,718, included an optional 1.2MB floppy disk drive, an extra 512K of video RAM, a 3270 card, and an IBM mouse. Few buyers ever pay full list for IBM systems; however, even after a likely 25 percent discount, this computer would be among the highest-priced units we tested.

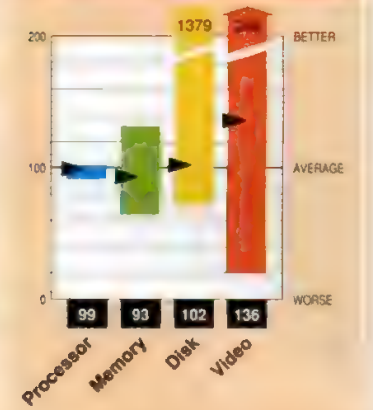
This 5.5- by 17.5- by 17.5-inch (HWD) desktop PC has room for one accessible 5.25-inch device and three 3.5-inch devices, one of which is accessible. The standard system comes equipped with a 3.5-inch floppy and a 3.5-inch hard disk, leaving two bays available. The 194-watt power supply sprouts only three device connectors; however, the power for the standard floppy disk drive comes via the drive connector, not a power supply lead.

There are four 32-bit MCA expansion slots. But because I/O, video, and the floppy disk controller are integrated on the system board, and because only one of the slots is used for the SCSI hard disk controller, the 90 still has three free slots.

IBM makes its own motherboard and BIOS, and the processor and relevant circuitry is mounted on a CPU card that plugs into the motherboard, making this system ready for simple processor upgrades. The system's memory is mounted on cards that plug into two special memory card slots. The system requires a minimum of 4MB RAM and can handle a maximum of 32MB, with 16MB on each memory card in 4MB SIMM increments. A 4MB RAM upgrade currently costs a painful $1,095.

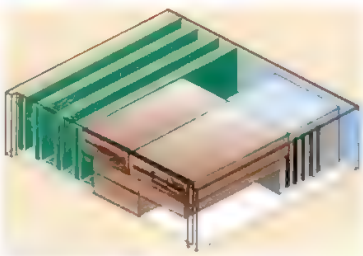
Two other pricey memory-related options also plug into the motherboard. IBM's base Model 90 doesn't include a RAM cache, and the 256K 20-nanosecond optional cache costs a breath-taking $1,995. To reach the maximum 1MB of video RAM, you'll pay an additional $350. Our standard configuration machine price includes the RAM cache; the price for the system we tested also includes the extra video RAM.

IBM PS/2 MODEL 90XP 486 OJ9



In Short: The founder of Micro Channel architecture garnered the best disk and video scores among the three MCA systems we have tested, though its caching disk controller performed as if it were uncached. IBM says that XGA video speeds up graphics application times greatly, but our tests are not designed to measure the difference. This tightly integrated, smallish 25-MHz desktop system has an FCC Class B rating and is highly recommended for quality, but the price is hard to justify.

FACT FILE



IBM PS/2 Model 90XP 486 OJ9
IBM Corp., 1133 Westchester Ave., White Plains, NY 10604; 800-426-2468.
List price (tested configuration): $18,718.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: IBM 16-ms. 160MB SCSI; IBM controller, 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: IBM 1,024 by 768 circuitry with 1MB RAM, IBM 14-inch monitor.
Software: DOS 4.01.

CIRCLE 402 ON READER SERVICE CARD

A MODERATE PERFORMER

The Model 90 did well—but not outstandingly so—on the PC Magazine Labs benchmark tests, scoring average times on processor, memory, and disk tests. The benefits of its biggest technological advance, XGA video, don't factor into the text mode test. Instead, where XGA shines is in graphics-intensive applications such as *Windows*, where XGA's 32-bit data path and bus-mastering capabilities can really take off.

If you jump to a PS/2 Model 90 with a 33-MHz 486 processor, you also get a 320MB hard disk for a total system price of $21,270, or $3,980 more than the 25-MHz with the 160MB drive. A similarly equipped 25-MHz 386-based PS/2 Model 70 with no RAM cache and with a 120MB hard disk carries a list price of $10,610, or $6,680 less than our standard configuration Model 90.

IBM systems are sold only through authorized dealers, with a one-year parts-and-labor warranty. IBM offers no standard on-site service contract, although several types of service contracts are available through dealers. If you have a problem with any IBM system, you can have it repaired at any IBM dealer or return it directly to an IBM service depot. Since local dealer service reputations can vary widely, it makes sense to get dealer recommendations from other users.

In short, this is a fine PC with an unbelieveably high price, especially

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InfoWorld Report Card				January 7, 1991
Professional Word Processors	Ami Pro® 1.2b	Wordstar® 6.0	Word for Windows	WordPerfect® 5.1
Basic editing	Very good	Very good	Excellent	Very good
Ease of learning	Very good	Good	Excellent	Very good
Ease of use	Very good	Good	Excellent	Very good
Overall score	7.8	6.6	8.3	8.0

"Companies would be wise to choose Word for Windows, which most likely will become the standard for Windows word processing."
—PC Week, December 24, 1990

"Word's collapsible outlining and easy-to-manage formatting via stylesheets should now have been emulated by every other word processor, but nothing else comes close."
—PC Magazine, December 11, 1990

"...it is amazingly easy to learn and use." —InfoWorld, January 7, 1991

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COMPUADD 320sc:

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PC Magazine, April 30, 1991

That's *PC Magazine* talking about its latest look at nine cached 386SX/20 systems.

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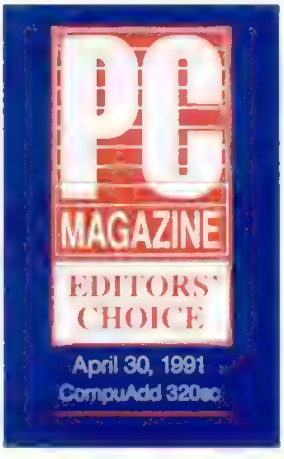

That "well-designed motherboard" has everything built on to it — "SIMM memory, floppy/hard disk controller, VGA video controller, and parallel and serial ports . . ." And the built-in Hi-Rez VGA controller gave the 320sc "a first-place finish on all video-related tests."

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*Hi-Rez VGA function incorporated on system board

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Features and flexibility	(175)	Satisfactory	Good	Very Good	Excellent	Very Good	Very Good
Rescheduling/resource leveling	(100)	Satisfactory	Satisfactory	Good	Excellent	Very Good	Very Good
Speed	(75)	Satisfactory	Very Good	Excellent	Very Good	Very Good	Satisfactory
Reporting	(100)	Good	Good	Good	Very Good	Very Good	Very Good
Documentation	(75)	Very Good	Good	Very Good	Very Good	Good	Very Good
Ease of learning	(100)	Very Good	Very Good	Very Good	Very Good	Good	Very Good
Ease of use	(125)	Good	Good	Very Good	Excellent	Good	Good
Error handling	(75)	Good	Good	Satisfactory	Very Good	Good	Very Good
Support							
Support policies	(50)	Good	Good	Very Good	Good	Good	Very Good
Technical support	(50)	Very Good	Very Good	Satisfactory	Excellent	Satisfactory	Very Good
Value	(75)	Satisfactory	Good	Very Good	Excellent	Very Good	Very Good
Final scores		**6.0**	**6.4**	**7.1**	**8.7**	**6.8**	**7.1**

Source: *InfoWorld*, November 26, 1990

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when you can get much the same performance with better expansion room for one third the money. On the other hand, if money's no object and if you don't need lots of drive and card expansion space, the Model 90's rock-solid design, component upgrade ease, and XGA video are all good reasons to consider this computer.

INDUSTRIAL DATA SYSTEMS INC.

Industrial Data Systems Cache 486 25

by Greg Pastrick

The purpose of a rack-mounted computer system is obvious. It's meant to take the worst a punishing environment can dish out while being easily accessible and fully functional in the hands of many users. It's not a personal computer; it's a factory machine. And no doubt about it, from its steel-wrapped, membrane-sealed keyboard to its fully enclosed nickel-plated chassis with 11-gauge cold-rolled steel face plates, the Industrial Data Systems Cache 486 25 is an industrial-strength ISA. However, brute strength aside, the IDS machine shows some flaws that merit closer attention when you're shopping around for a shop-floor system.

Under *PC Magazine*'s standard configuration, which includes 8MB of RAM, 64K of processor RAM cache, a 200MB hard disk, a 1.2MB floppy disk drive, a Super VGA video adapter with VGA display, and DOS 4.01, the system sells for $14,240 (a $3,000 increase over a similarly configured 33-MHz 386-based IDS). However, Industrial Data Systems offers a wide range of options and configurations for its PCs. The rack-mount, mini-tower, and tower chassis options come with active motherboards or 8- and 14-slot passive backplane motherboards.

The company also offers a list of desktop and rack-mounted monitors ranging from a 14-inch monochrome monitor to a 20-inch 1,024- by 768-pixel monitor, as well as a selection of 16-bit VGA and 8514 video controllers. A full complement of numeric coprocessors and 80-nanosecond DRAM on SIMM expansion cards is available also. Hard disk options range from a 40MB IDE drive to a 330MB ESDI drive and an internal 40MB tape drive. To complete this menu, IDS offers an internal UPS and a 100-key keyboard with built-in trackball.

MIXED PERFORMANCE

The IDS Cache 486 25 was among the fastest PCs in our review group on PC Magazine Labs' processor tests. This success was mitigated by below-average disk access test times and the slowest memory access times in our review group.

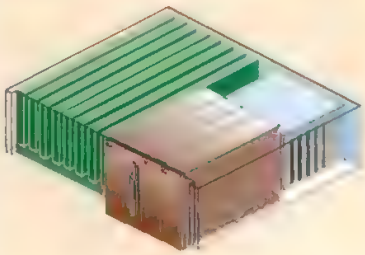
The IDS Cache 486/25's VGA performance was aided considerably by Tseng Laboratories' Super VGA card with 1MB of video memory, though the maximum resolution on the Packard-Bell display that came with the system we tested is 640 by 480.

Worse than its disk and memory performance characteristics were flaws in its rack-mount case design. Although the four half-height drive bays are adequately protected with a locking steel door, the reset switch on the front control panel is open and unguarded. The company would do well to add a cover for the control panel, as well. Inside the 8.8- by 19- by 17.5-inch (HWD) case, mount holes for the hard disk drive were misaligned, leaving the 19-millisecond Conner hard disk mounted at an angle. Although this has a negligible effect on hard disk performance, it is indicative of sloppy manufacturing. The IDS has eight slots: one 32-bit and seven 16-bit. With the video and IDE cards installed, six are available.

IDS offers a one-year warranty on parts and labor. You must return the unit to the manufacturer for service. Backup on-site service from GE is included in the purchase price.

All things considered, the strength of this system is in its case. If you favor ruggedness over performance or if you absolutely need a rack-mounted system, check out the IDS Cache 486 25. Otherwise you'll find less-expensive alternatives with better performance characteristics elsewhere.

FACT FILE

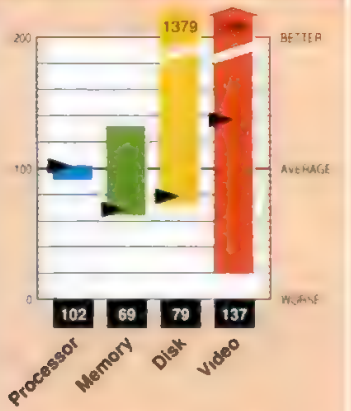


Industrial Data Systems Cache 486 25
Industrial Data Systems Inc., 14900 Woodham Dr., #170, Houston, TX 77073; 713-821-3200.
List price (tested configuration): $14,240.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 64K cache.
Disk drives and controller: Conner 19-ms. 220MB IDE, 1.2MB floppy disk drive.
Display: Tseng Labs Super VGA adapter with 1MB RAM. Packard-Bell 14-inch monitor.
Software: DOS 4.01.

CIRCLE 403 ON READER SERVICE CARD

INDUSTRIAL DATA SYSTEMS CACHE 486 25

TEST RESULTS



In Short: Consider the Industrial Data Systems Cache 486 25 for its rack-mount design and purpose, not its 486 performance. Like other systems built on the ISA-based DTK motherboard, the IDS was below average on our disk test and poor on our memory test. Despite some minor design flaws, the case of nickel plate and rolled steel affords solid protection for shop-floor computing. The company offers an extensive list of options and configurations.

INSIGHT COMPUTERS

Insight 486-25

by Greg Pastrick

The distinguishing mark of an otherwise average 25-MHz 486 ISA machine has to be its price. In view of the low price that Insight Computers has put on *PC Magazine*'s standard-configuration model, the company scores well on this point.

In fact, at $3,695 for 8MB RAM, a 209MB hard disk, 1.2MB and 1.44MB floppy disk drives, 128K of external processor RAM cache, and a Super VGA display system, the Insight 486-25 is one of the least expensive machines in our review group. What's more, upgrade to a 340MB or 660MB ESDI hard disk and you're still looking at high-capacity 486 computing for between $4,200 and $4,800. The key to this is the basic Insight 486 system, which is priced at a startling $2,195 and includes 1MB RAM, a 40MB hard disk, a 1.2MB floppy disk, and a monochrome video system.

From its OPTi chip set and Toshiba floppy disk drives to its Conner Peripherals hard disk and Boca Research Super VGA card, this 23- by 6.8- by 19.3-inch (HWD) tower is outfitted with fairly typical brand-name components. Insight can put together a system with enough expansion card and drive possibilities to cover just about any personal or workgroup computing needs. Other components include a Chinon internal tape drive ($449) and a Toshiba CD-ROM drive ($669), as well as 2,400- and 9,600-bps modems for $77 and $449, respectively.

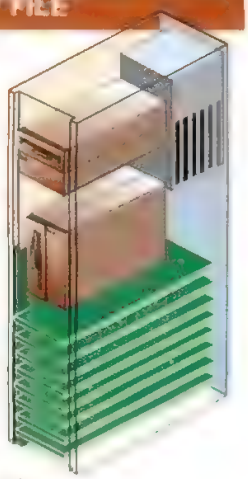
The Insight 486-25 scored its best showing on PC Magazine Labs' conventional memory tests, showing better-than-average times. Its video times were a little faster than average as well, but its processor and disk access ratings were lower than average on both counts. The healthy 128K of processor cache RAM is hampered by its 35-nanosecond chips. This is not surprising, considering that most other cached systems use 20- or 25-ns. memory for their RAM caches. However, the CPU is based on an unfamiliar 16-bit ISA motherboard labeled Armas in the documentation (though based on the familiar OPTi chip set). The no-name IDE controller contributed little to the performance of the installed drives.

The 486-25's video times were only slightly better than average; however, a better video subsystem selection offered by Insight consists of a $199 Orchid ProDesigner II graphics adapter teamed with a $649 Sony 1304 monitor. Oddly, the SuZiba monitor that came with the test unit had no front-mounted controls. Worse, the 1.44MB Toshiba floppy disk wasn't working on our test unit; Insight said they'd had some returns on this drive. On a more positive note, the Chicony keyboard that came with the system is tops—accept nothing less.

Insight's one-year warranty is backed by phone service for parts shipping and a 30-day money-back guarantee. There is a toll-free technical support number available to customers during normal business hours, Monday through Friday.

If the Insight 486-25 doesn't particularly move you, you might stick with Insight anyway simply for the variety of systems you can put together from the company's nine-page advertisment/price list. At these prices, it might just be worth the picking and choosing.

FACT FILE

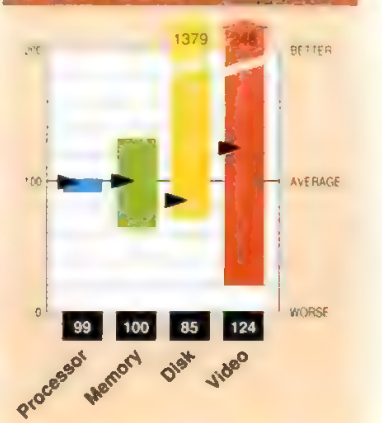


Insight 486-25
Insight Computers, 1912 W. Fourth St., Tempe, AZ 85281; 800-776-7600, 602-350-1176.
List price (tested configuration): $3,695.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Conner 25-ms. 209MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Boca Research 1,024 by 768 adapter with 1MB RAM, Suziba 14-inch monitor.
Software: DOS 4.01.

CIRCLE 404 ON READER SERVICE CARD

INSIGHT 486-25

TEST RESULTS



In Short: In our tested configuration, the ISA-based Insight 486-25 is just an average performer. The options available from this direct marketer are virtually unlimited, however. The Armas/Aten motherboard may be unfamiliar, but there is ample room for memory and device expansion to handle most personal and workgroup computing needs.

INTERNATIONAL INSTRUMENTATION INC.

Blue Max Monolith 486/250E

by Bruce Brown

The biggest news about International Instrumentation's EISA-bus Blue M Monolith 486/250E is its price. You buy a standard-configuration syster includes a one-year on-site servic tract for under $5,000. Combine this with the Blue Max's strong benchmark test scores and superior expansion capabilities, and you've got a good box at a good price.

At $4,916, the Blue Max in *PC Magazine*'s standard configuration has 8MB RAM with a 64K processor RAM cache, a 200MB hard disk, a 1.2MB or 1.44MB

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- New easy-to-use, windows-style interface with Express Menu
- Advanced error correction for recovering data from damaged disks

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*U.S. destinations only. Fastback Plus 3.0 will not restore backups made with versions 2.09 or earlier.

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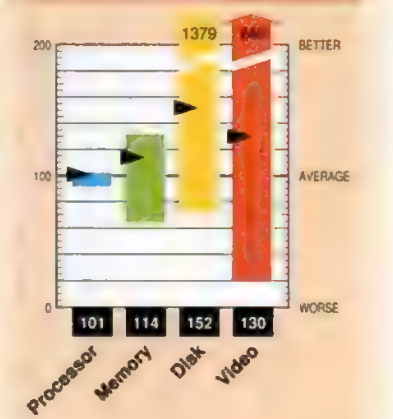
CIRCLE 286 ON READER SERVICE CARD

MONOLITH 486/250E



In Short: All the test results look fine for the Blue Max Monolith 486/250E. A 512K caching EISA controller from UltraStor contributed to the speedy disk test score. The standard eight-bay tower case, with accommodation for up to 96MB of RAM and a dual-fan cooling system with a heat-sensing chip set, makes this a good system for file server duties. Add aggressive pricing and standard on-site service from TRW and a better EISA deal is hard to find.

floppy disk drive, an Orchid ProDesigner II video board with 1MB video RAM, a full-size tower case, and a VGA monitor. Our test system came in a desktop case that cost $100 less; it had an UltraStor 512K caching controller and a Hewlett-Packard 338MB, 15-millisecond hard disk with its own five-year warranty. The price of the test system is $6,497.

III uses an AMI Enterprise motherboard with AMI BIOS, an Intel EISA chip set, and a variable-speed bus controlled by the CMOS setup. A socket on the motherboard accepts a 25-MHz Weitek math coprocessor ($895).

The motherboard has eight SIMM memory module slots that can take either 1MB or 4MB modules. The maximum on-board memory is 32MB, but you can add a 64MB memory card. Our test system used 8 1MB, 70-nanosecond SIMMs. The 64K processor RAM cache (expandable to 256K) uses speedy 15-ns. SRAMs.

The machine has eight 32-bit EISA-style slots and one 32-bit proprietary slot for the memory add-on board. Our test machine had a 230-watt Senstrom power supply, although the standard unit delivers 250 watts and includes six power leads plus two splitters. Of the eight drive bays in the standard case, six are accessible 5.25-inch half height bays; the other two can hold internal 3.5-inch drives. The tower case also includes a second cooling fan controlled by a temperature-sensing chip set.

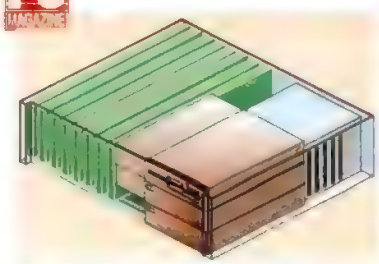
III sells systems through dealers and VARS, by mail order, and also through a staff that largely sells direct to the aerospace industry and local government agencies. While at the time of the review III's 486 systems comprised only about 10 percent of its total sales, the vendor reports increased interest in its 486 machines, especially in the EISA version for users who want the advantage of the EISA bus's higher data-transfer rate.

There are several price points of comparison with other III machines. For those who need the fastest processor now available, III sells the same system with a 33-MHz EISA board for $600 more. An identically configured 25-MHz 486 ISA machine sells for $400 less than the EISA version, and a 33-MHz 386 ISA will cost you $1,250 less than the 25-MHz EISA. It would be easy to argue that anyone buying an EISA system ought to opt for the 33-MHz system, but the price premium may waste your money, especially in applications where data transfer is the bottleneck. In that case the 25-MHz EISA machine sounds like the best bet; it certainly gives you a lot of performance for the money.

III has recently taken on more aggressive service and support policies. The standard one-year parts-and-labor warranty is now backed by standard on-site service from TRW throughout the United States (except for the Los Angeles, California, area, where service is provided at III's facility). There is no fixed-period money-back guarantee policy, but if a system clearly does not meet a user's needs, the company's policy is to consider returning the purchase price. Toll-free technical support is available 8:30 A.M. to 6:00 P.M., Monday through Thursday, and 8:00 A.M. to 5:30 P.M. on Fridays. Service personnel are often available on a catch-as-catch-can basis on Saturdays.

The III Blue Max Monolith 486/250E is a good buy. With the exception of its performance on our video tests, which was average, its performance was consistently in the top of our review group. Its expansion capabilities in the standard case are better than average, and the price is certainly right. Add newly competitive service and support policies, and this one looks like a winner.

FACT FILE



Blue Max Monolith 486/250E
International Instrumentation Inc., 2282 Townsgate Rd., Westlake Village, CA 91361; 800-543-3475, 805-495-7673.
List price (tested configuration): $6,497.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 64K cache.
Disk drives and controller: Hewlett-Packard 15-ms. 338MB ESDI; UltraStor controller, 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 512K RAM, Samsung 14-inch monitor.
Software: DOS 4.01.

CIRCLE 405 ON READER SERVICE CARD

KRIS TECHNOLOGIES

KRIS 48C-2
KRIS 48E-2

by Henry Fersko-Weiss

KRIS Technologies offers you a choice between ISA and EISA 25-MHz 486-based computers. The two computers use motherboards from the same manufacturer and can use the same hard disk and video card. But the similarity ends there;

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BENCHMARK TESTS: 25-MHz 486-BASED PCs

Make sure that your applications actually use an external processor RAM cache before you invest hundreds of dollars in that feature. Our tests show that the extra cache made practically no difference in a tightly clustered group of scores. But with a 486/25, you can expect to reduce the performance times of 33-MHz 386s by 10 to 15 percent.

TESTING ANALYSIS

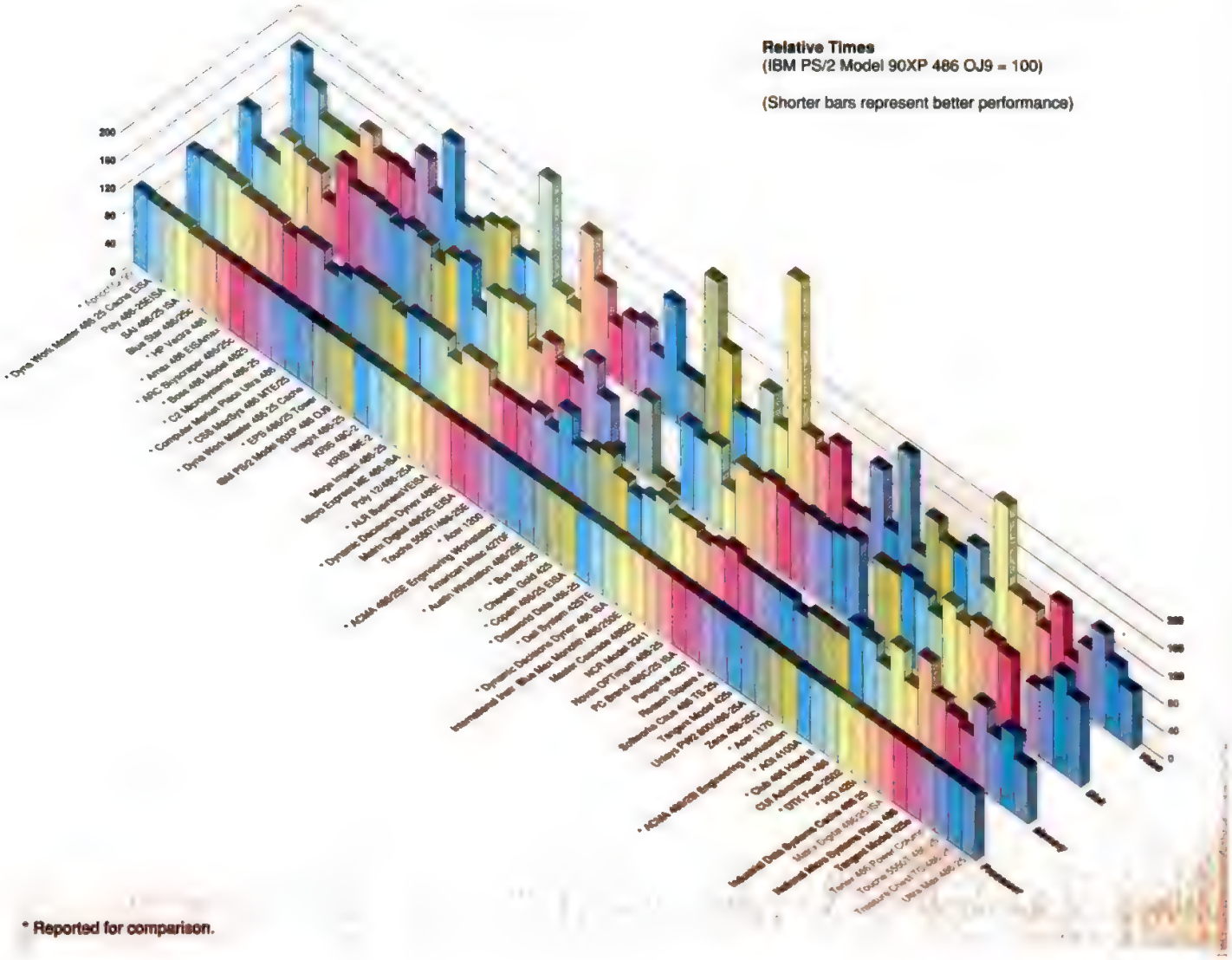
Regardless of bus architecture, both processor and memory times are tightly clustered: Only a few scores stand out, on the slow side. External processor RAM cache made no difference in the processor test scores: Some of the fastest performers (such as the Acer 1170) used no cache beyond the 8K built into the i486 chip, while some of the slowest (such as the Dyna Work Master 486 25 Cache EISA) had 256K.

On the other hand, disk caching makes a tremendous difference. The slowest systems had uncached controllers, and their disk test scores ranged from 48.90 to 72.42 seconds. A second group, with scores from 33.79 to 38.58 seconds, had controllers with up to 1MB of cache on-board. Five systems came with caching controllers and on-board microprocessors; all produced scores below 7 seconds. The only system that bucked this trend was the IBM PS/2 Model 90XP 486 OJ9. Despite a 256K cache, this system's disk score was comparable to those of the uncached machines.

As for video performance, systems based on the Tseng Laboratories chip set had the fastest video scores. Of all the video adapters, the Tseng-based Diamond SpeedSTAR video card registered the fastest performance.

Relative Times
(IBM PS/2 Model 90XP 486 OJ9 = 100)

(Shorter bars represent better performance)



* Reported for comparison.

HOW WE TESTED

In testing these 61 486 25-MHz ISA, MCA, and EISA systems, we used PC Magazine Labs' Hardware Performance Tests, Release 5.6, with video and system shadowing enabled wherever possible and with buffers left at their default values. No software disk caches were used when performing disk benchmark tests, and no RAM-resident programs were loaded for any tests.

We accepted up to 1MB of cache on EISA and MCA hard disk controllers, though we allowed only one caching ISA controller: The Cheetah Gold 425 comes exclusively with the controller we reviewed. The margin of error for the processor, memory, and video benchmark tests is 0.05 seconds, so take this into account when making purchasing decisions based primarily on speed.

	Processor (seconds)	Memory (seconds)	Disk (seconds)	Video (seconds)
* Apricot QI 900	1.61	0.30	60.25	1.81
* Dyna Work Master 486 25 Cache EISA	1.58	0.31	38.58	1.38
Poly 486-25EISA	1.57	0.31	37.51	0.88
SAI 486/25 ISA	1.56	0.30	59.79	0.88
Blue Star 486/25c	1.49	0.26	54.90	0.88
* HP Vectra 486	1.49	0.28	52.16	1.26
* Amax 486 EISAmax	1.48	0.27	35.92	0.99
* ARC Skyscraper 486/25c	1.48	0.25	72.20	1.04
* Boss 486 Model 4625	1.48	0.26	58.86	0.99
* C² Microsystems 486-25	1.48	0.28	60.05	1.54
* Computer Market Place Ultra 486	1.48	0.22	58.03	0.98
* CSS MaxSys 486 MTE/25	1.48	0.25	54.08	2.14
* Dyna Work Master 486 25 Cache	1.48	0.28	60.24	0.87
* EPS 486/25 Tower	1.48	0.28	57.53	0.98
IBM PS/2 Model 90XP 486 OJ9	1.48	0.27	50.18	1.21
Insight 486-25	1.48	0.25	60.35	1.32
KRIS 48C-2	1.48	0.28	64.44	0.99
KRIS 48E-2	1.48	0.28	36.08	1.10
Mega Impact 486-25	1.48	0.28	54.48	2.69
Micro Express ME 486-ISA	1.48	0.22	57.69	0.88
Poly 12/486-25A	1.48	0.28	60.12	0.77
* ALR BusinessVEISA	1.46	0.28	36.06	2.25
* Dynamic Decisions Dynex 486E	1.46	0.22	49.25	1.54
Matrix Digital 486/25 EISA	1.46	0.22	36.98	0.99
Touche 5550T/486-25E	1.46	0.22	35.75	1.27
* Acer 1200	1.45	0.25	56.86	1.37
* ACMA 486/25E Engineering Workstation	1.45	0.22	35.84	0.99
American Mitac 4270F	1.45	0.33	4.05 ❶	2.09
* Austin Winstation 486/25E	1.45	0.22	34.89	0.99
* Bus 486-25	1.45	0.25	56.83	0.99
* Cheetah Gold 425	1.45	0.28	6.94	3.02
* Copam 486/25 EISA	1.45	0.22	3.85	1.92
* Dataworld Data 486-25	1.45	0.19	60.18	0.99
* Dell System 425TE	1.45	0.22	55.19	1.04
* Dynamic Decisions Dynex 486 ISA	1.45	0.25	60.67	1.75
International Instr. Blue Max Monolith 486/250E	1.45	0.22	33.79	1.26
Master Cascade 48625	1.45	0.22	57.71	4.05 ❷
NCR Model 3341	1.45	0.20	56.03	1.48
Novas OPTImum 486-25	1.45	0.22	61.70	1.32
PC Brand 486C/25 ISA	1.45	0.25	57.71	1.65
Peregrine 425T	1.45	0.22	54.77	0.66
Reason Square 4	1.45	0.22	57.68	0.71 ❸
Softworks Citus 486 TS 25I	1.45	0.22	55.26	1.76 ❸
Tangent Model 425I	1.45	0.22	58.20	0.82
Unisys PW2 800/486-25A	1.45	0.19	63.00	2.36
Zeos 486-25C	1.45	0.22	3.73 ❶	0.77
* Acer 1170	1.44	0.22	58.88	1.54 ❸
* ACMA 486/25I Engineering Workstation	1.44	0.22	59.53	1.26
* AGI 4100A	1.44	0.30	64.75	1.27
* Club 486 Hawk II	1.44	0.28	58.48	1.59
CUI Advantage 486	1.44	0.22	50.01	1.04
* DTK Feat-2502	1.44	0.33	65.99	2.69
* HIQ 425I	1.44	0.22	58.22	1.26
Industrial Data Systems Cache 486 25	1.44	0.36 ❶	65.19	1.20
Matrix Digital 486/25 ISA	1.44	0.25	60.17	0.99
National Micro Systems Flash 486	1.44	0.22	57.30	1.64
Tangent Model 425e	1.44	0.19	3.90 ❶	0.82
Tenex 486 Power Column	1.44	0.34	48.90	1.21
Touche 5550T/486-25	1.44	0.25	55.13	1.65
Treasure Chest TC 486-25	1.44	0.31	72.42 ❸	1.26
Ultra-Max 486-25	1.44	0.22	60.56	0.99

HIGHLIGHTS

● **American Mitac, Zeos, Tangent Model 425e: Disk**
These three machines had Mylex hard disk caching controllers with 1MB of RAM. Because of the microprocessor on this board, the disk scores are exceptionally fast.

● **Master Cascade: Video**
Additional VGA testing at PC Labs showed that the Master Cascade 48625's Trident video board failed to use the 16-bit data path effectively—hence the poor video score.

● **Reason, Softworks, Acer 1170: Video**
These three excellent video timings can be attributed to the Diamond SpeedSTAR video card installed in each system.

● **Industrial Data Systems: Memory**
While this system had a poor memory test score, it performed well on the processor benchmark test. This was typical of systems based on the DTK motherboard.

● **Treasure Chest: Disk**
IDE drives tend to be slower than ESDI and SCSI drives. This system's Seagate hard disk has turned in poor test scores in the past.

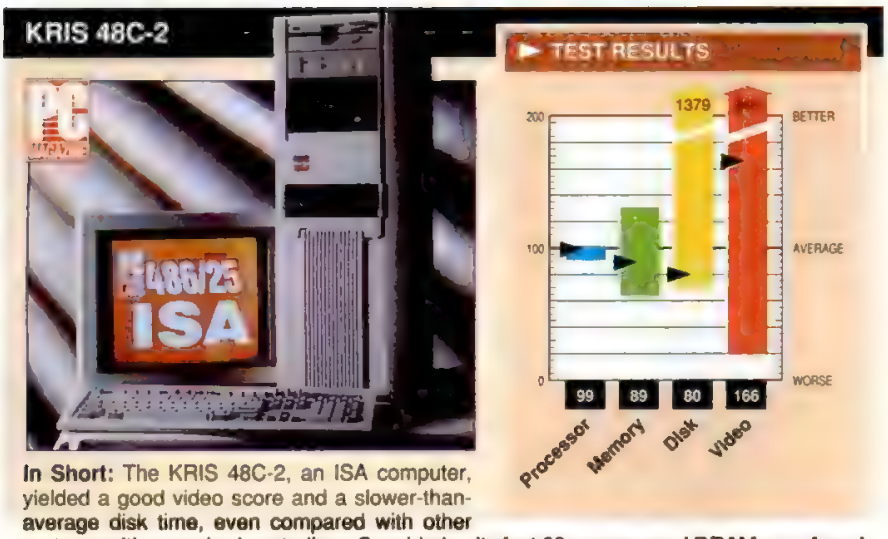
■ The **Instruction Mix** benchmark test times a series of tasks specific to the processor. Since this test shows how the CPU operates in the context of the bus, processor, system memory, and motherboard architecture, a faster time means better overall computer performance.

■ The **Conventional Memory** benchmark test measures the read/write speed of the first 640K of memory. Slower relative times can indicate the presence of memory wait states or memory chips rated at relatively slow access speeds.

■ The disk score is the sum of the small-record and large-record **DOS File Access** benchmark test times. Each test times disk throughput as a result of mechanical disk drive speed, hard disk controller function, and bus speed. No software cache is employed.

The **Direct to Screen** benchmark test indicates the speed of the video adapter memory. A good score indicates that information can get to the screen quickly, particularly when programs bypass the computer's video BIOS.

* Reported for comparison.



In Short: The KRIS 48C-2, an ISA computer, yielded a good video score and a slower-than-average disk time, even compared with other systems with uncached controllers. Considering its fast 60-nanosecond DRAMs, we found its memory score somewhat disappointing. This machine shows no real advantages or disadvantages relative to other average systems, either in features, price, or performance.

you'll find significant differences in looks, expansion capabilities, performance characteristics, and price.

PC Magazine's standard configuration of the KRIS 48C-2 ISA computer costs $7,880 with 8MB of RAM, a 128K processor RAM cache, a 150MB hard disk, a 1.2MB or 1.44MB floppy disk drive, and a Super VGA subsystem. The machine we tested, with a 337MB hard disk and 1MB of RAM on the video card, sells for $9,559.

The KRIS 48E-2 EISA computer costs $9,869 in *PC Magazine*'s standard configuration, including an EISA hard disk controller card with a 1MB cache and 1MB of RAM on the video card. As tested, with the 337MB hard disk, the unit sells for $10,929.

Although both computers come in tower cases, they could hardly be more different in appearance. The KRIS 48C-2 (ISA) is beige and rests on a plastic stand that runs around its bottom like a skirt. The power, reset, and turbo buttons, as well as a digital turbo display and a keyboard lock, are all located behind a tinted plastic cover. Four half-height drive bays are accessible from the front.

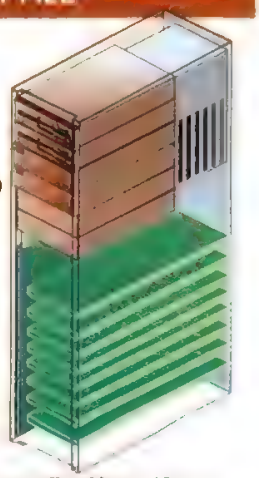
The KRIS 48E-2 (EISA) is black with a marble-finish plastic face and sits on wheels for easy transportation. Although it has just about the same height and depth measurements, it's about 3.5 inches wider and has a corresponding increase in internal capacity. Its elegant facade has LED lights for power, two hard disks, a COM1 port, and a tape drive. There is no turbo button or turbo indicator, no reset switch, and the power switch is in the back. The keyboard lock is in the front and a case lock is on the side. The 48E-2 also has four accessible half-height drive bays that are protected from dust by a tinted plastic door that pops open when you press it.

INNER DIFFERENCES

The ISA computer has six half-height drive bays ranged along the front. The EISA has eight half-height drive bays down the front and a bracket mounted on the lower side for two more. Since the EISA's case opens from both the side and front it's very easy to install the drives and reach the connectors. Both machines use 250-watt power supplies.

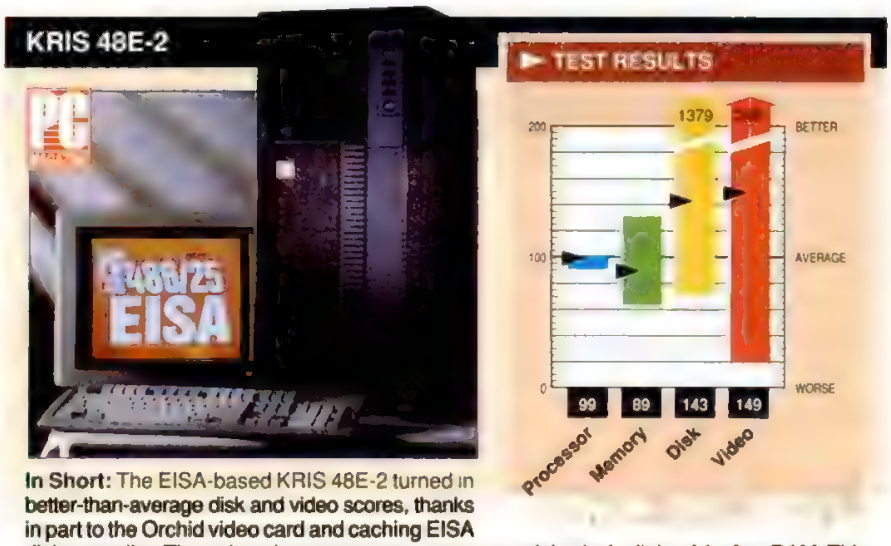
Both machines use motherboards from Advanced Integration Research, although the ISA's BIOS is from AMI and the EISA's BIOS is from Phoenix. Both boards have 16 SIMM slots for the RAM, but the ISA machine can only support

FACT FILE



KRIS 48C-2
KRIS Technologies, 260 E. Grand Ave., San Francisco, CA 94080; 800-282-5747, 415-875-6729.
List price (tested configuration): $9,559.
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 16-ms. 337MB ESDI, DTC controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, KRIS 14-inch monitor.
Software: DOS 4.01.

CIRCLE 436 ON READER SERVICE CARD



In Short: The EISA-based KRIS 48E-2 turned in better-than-average disk and video scores, thanks in part to the Orchid video card and caching EISA disk controller. The rather slow memory score was surprising in the light of the fast RAM. This tower system has ample room for storage, with its ten drive bays, but little else puts it above the ranks of similarly configured clones.

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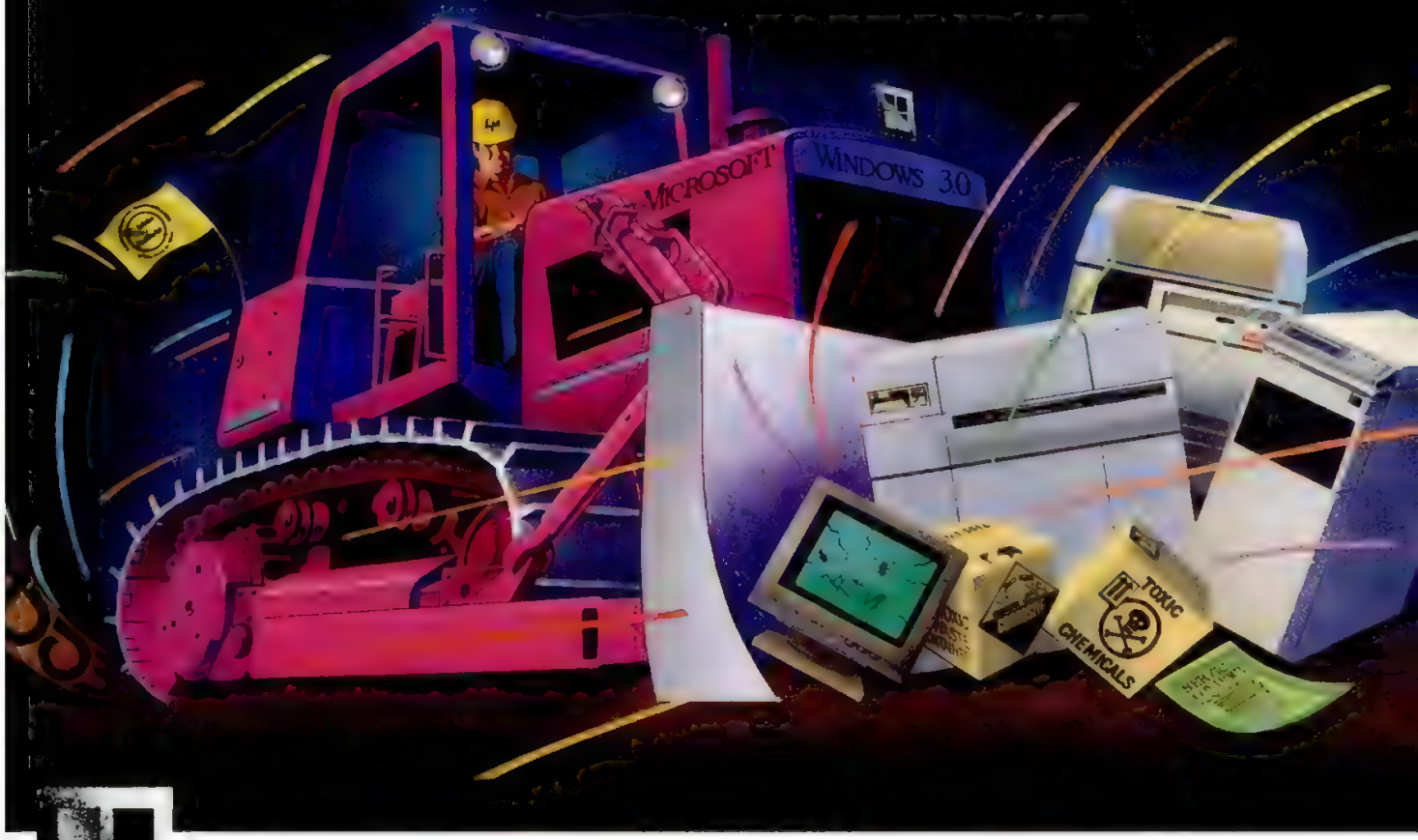

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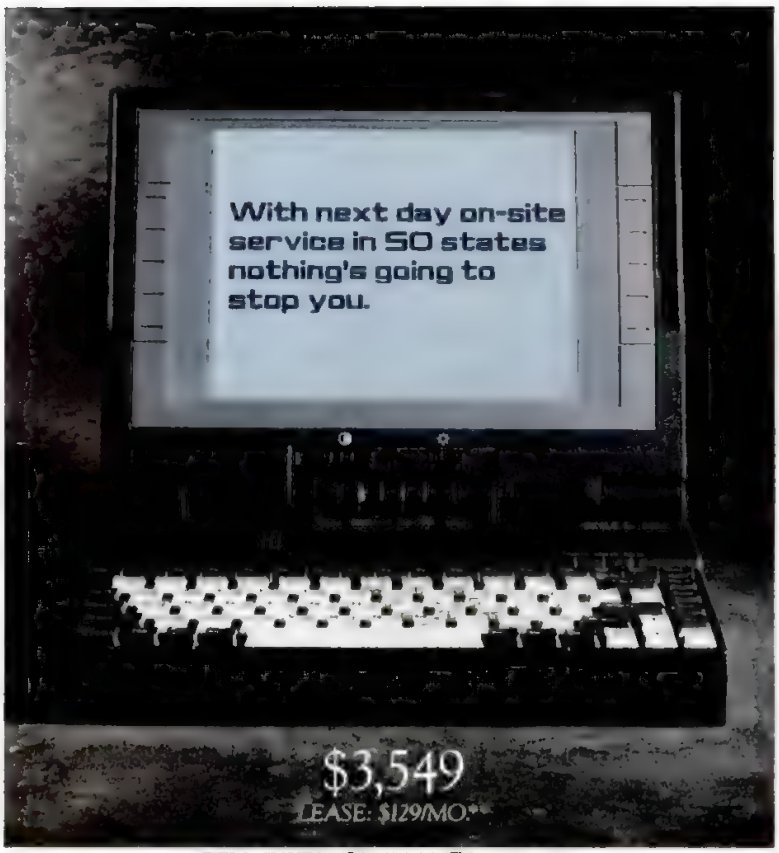

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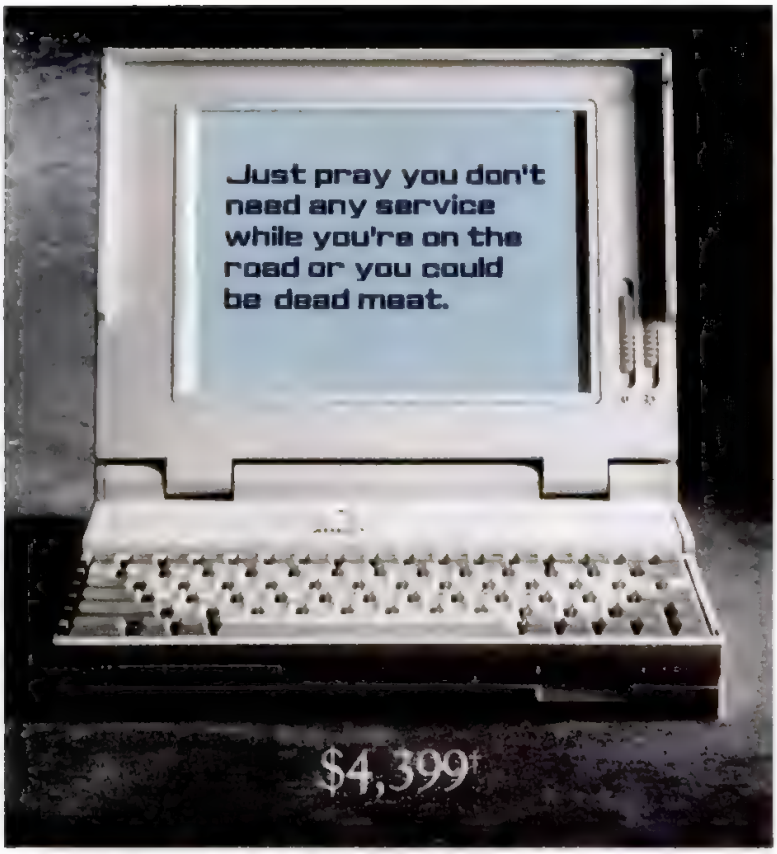

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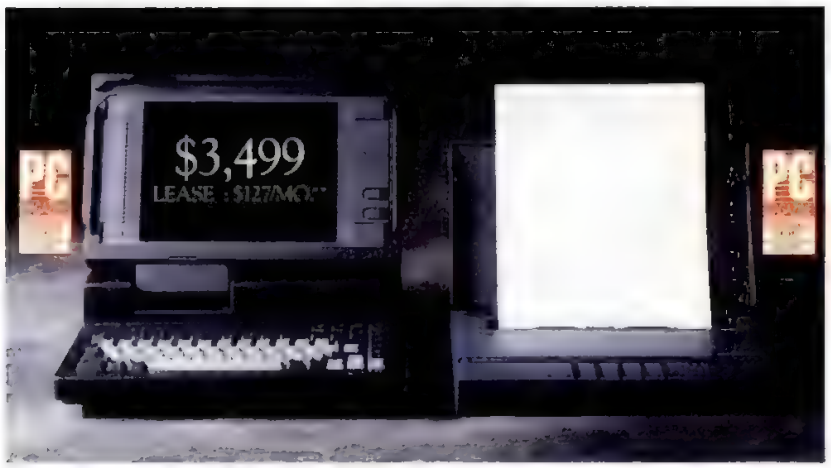

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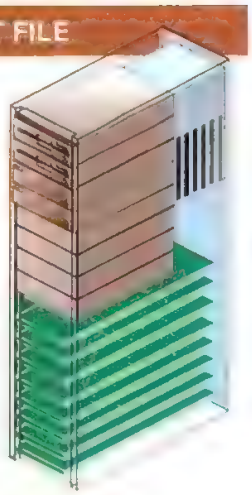

KRIS 48E-2
KRIS Technologies, 260 E. Grand Ave., San Francisco, CA 94080; 800-282-5747, 415-875-6729.
List price (tested configuration): $10,929.
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 16-ms. 337MB ESDI, DTC controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, KRIS 14-inch monitor.
Software: DOS 4.01.

CIRCLE 407 ON READER SERVICE CARD

1MB SIMMs for a total of 16MB. The EISA can support up to 64MB using 4MB SIMMs. The two units we tested each had 8 1MB 60-nanosecond SIMMs and used 35-ns. memory for their 128K processor RAM caches. It wasn't surprising to find their average performance on the PC Labs Instruction Mix test virtually identical.

The two computers also came with the same hard disk: a 337MB, 16-millisecond Maxtor ESDI. In its rush to get us a test unit, KRIS sent the EISA computer with the same DTC disk controller as that of the ISA unit. The controller showed average performance for its class. The ISA machine was marginally slower than other systems in its class.

All the other peripherals in the two computers were the same, from the TEAC floppy disk drives to the Chicony keyboard, KRIS 1,024-by-768 monitor, and Orchid ProDesigner II video card. The ProDesigner II's Tseng chip set ensured better-than-average video performance results, though it performed better on the ISA system than on the EISA.

When it comes to service and support the two computers are treated exactly the same, with a reasonably generous two-year warranty on the parts and free labor for 18 months. KRIS says it is currently negotiating with an on-site service company and should have an on-site service plan in place by the time you read this. The technical support line, which requires a

25-MHz 486-BASED PCs: SUMMARY OF FEATURES

List price (standard configuration) For this review of 25-MHz 80486-based computers, we requested a standard configuration that included 8MB of RAM, a 200MB to 300MB hard disk, one floppy disk drive, a Super VGA color display subsystem, one parallel and two serial ports, and DOS 4.01. All 32 PCs reviewed here provide a reasonably close match to this list of requirements.

The price of the standard configuration is followed by the **standard hard disk capacity.** Unless otherwise noted, all table entries refer to the range of options available in the systems reviewed.

Distribution channel Dealers often offer discounts of 25 percent or more off the list price (although there is no guarantee that the discounts will run this high). Direct mail-order vendors offer no such discounts.

80486 chip set manufacturer indicates which company makes the support logic that connects the CPU with the other functions managed by the system board. In some cases the computer uses discrete logic rather than a chip set.

System RAM arrangement refers to the method in which memory is addressed. Different arrangements aim at avoiding the wait states imposed when CPU speed outpaces conventional memory speed.

Page-mode architecture allows back-to-back memory accesses within banks of RAM defined as pages.

Interleaved RAM arrangement divides memory into two or four portions that process information alternately. The CPU sends information to one section for processing while another section undergoes a refresh cycle.

Systems may also use interleaving in conjunction with page-mode architecture. We refer to this arrangement as *interleaved page*.

Installable RAM indicates the minimum and maximum amount of memory that can be installed using any combination of chips and proprietary cards.

The **BIOS version** can affect PC Magazine Labs' benchmark test results. Those purchasing the same machine with a different BIOS version may encounter some variations in performance.

Setup can reside either on a floppy disk or in the computer's ROM.

Shadowing Shadow RAM is a technology that loads video BIOS or system BIOS directly into fast RAM on boot-up of the computer, offering enhanced performance speed. It uses a segment of system memory located between the boundary of conventional memory (640K) and the end of the first megabyte of installed RAM. With some applications, the ability to disable shadowing is important in resolving memory conflicts.

Hard disk options We report the range of hard disk capacities the vendor offers.

Minimal floppy disk configuration indicates whether the vendor equips its base-priced system with a 1.2MB or a 1.44MB floppy disk drive, or both.

Expansion slots For each type of expansion slot—8-bit, 16-bit, 32-bit EISA/MCA, and 32-bit proprietary—we report the total number of slots on the motherboard and the number of slots left open when the PC is equipped in our standard configuration.

Display mode refers to the resolution of the video card that comes in the tested configuration. For this review, we requested a Super VGA (800- by 600-pixel resolution) display, though we accepted 1,024-by-768 resolution as well.

The **display circuitry** can reside on an expansion card or on the motherboard. Motherboard circuitry is often faster, but if it cannot be disabled there is no way to upgrade it.

DOS versions and prices are listed here. If no price is given, the base-priced system includes DOS. (*PC Magazine*'s standard configuration includes DOS 4.01—or 3.3 if 4.01 is not available—to allow more-accurate price comparisons.)

Other bundled software is software that comes with the system at no extra charge. This category includes disk-caching software (such as SMARTDRV.SYS), expanded memory management software (such as *QEMM*), *Windows* 3.0, and any applications the vendor supplies as extras.

Number of device connectors indicates how many internal storage devices the power supply can support without requiring Y cables (power splitters).

FCC Class B identification number Systems with a Class B rating from the Federal Communications Commission can be purchased for home use. Systems listed as *B pending* have been submitted to the FCC for certification. Public Access Link, the FCC's bulletin board service (301-725-1072), lists every Class B and B-pending system by its FCC identification number.

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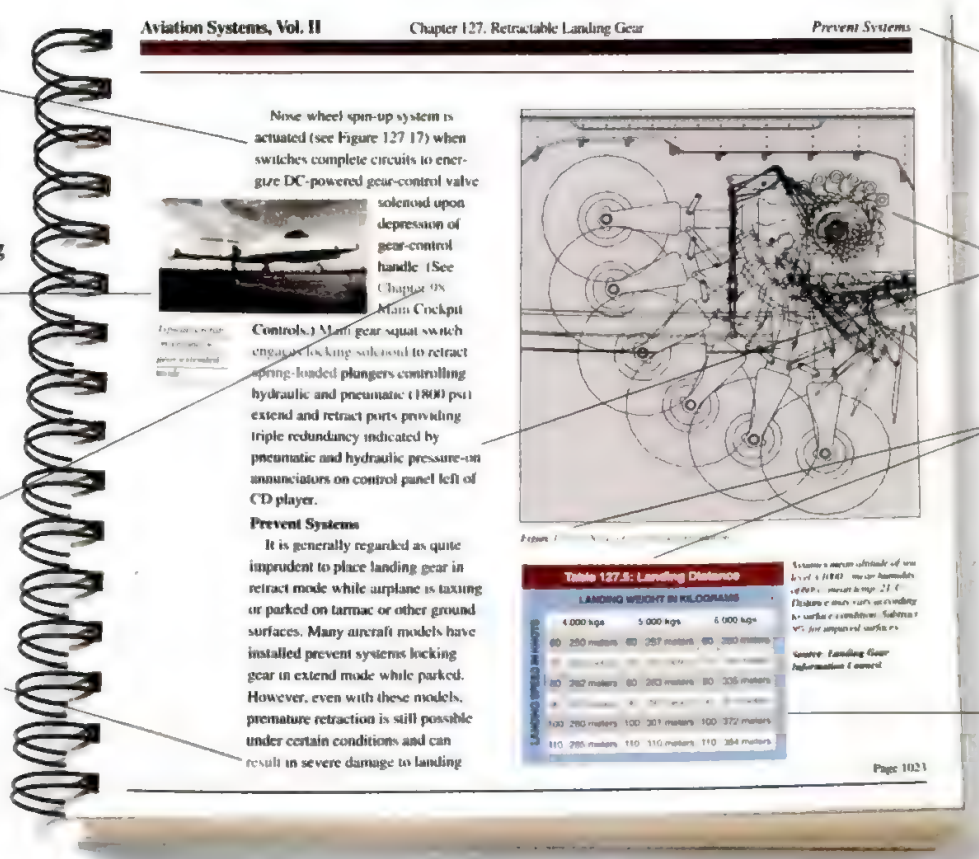

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25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	American Mitac 4270F	CUI Advantage 486	IBM PS/2 Model 90XP 486 0J9	Industrial Data Systems Cache 486 25	Insight 486-25	International Instrumentation Blue Max Monolith 486/250E	KRIS 48C-2
List price (standard configuration)	$10,843	$5,730	$17,290	$14,240	$3,645	$4,916	$7,880
Standard hard disk capacity	426.5MB	210MB	160MB	220MB	209MB	200MB	150MB
Distribution channel	Dealers	Dealers	Dealers	Direct	Direct	Dealers, direct	Dealers
Bus architecture	EISA	ISA	MCA	ISA	ISA	EISA	ISA
Case type	Small-footprint	Tower	Desktop	Rack-mount	Tower	Tower	Tower
Dimensions (HWD, in inches)	6.3 x 15 x 16.8	25.8 x 11 x 17.5	5.5 x 17.5 x 17.5	8.8 x 19 x 17.5	23 x 6.8 x 19.3	25.5 x 7.5 x 16.5	25.4 x 7.5 x 17.9
Motherboard manufacturer	Mitac	Free Technology	IBM	DTK	Armas	AMI	AIR
80486 chip set manufacturer	Intel	Intel	IBM	Discrete logic	C&T, OPTI	Intel	OPTI
System RAM arrangement	Page mode	Page mode	Interleaved	Page mode	Page mode	Interleaved page	Interleaved page
MEMORY AND PROCESSOR RAM CACHE							
Installable RAM	4MB–64MB	1MB–16MB	4MB–32MB	1MB–16MB	1MB–16MB	1MB–96MB	1MB–16MB
Cache controller	GLU Logic	Discrete logic	IBM	Discrete logic	Discrete logic	Discrete logic	Discrete logic
Installable cache RAM	128K–256K	64K–256K	256K	256K	128K	64K–256K	128K–256K
BIOS							
BIOS version	Phoenix 1.00	AMI 1.2F	IBM (August 1990)	Phoenix/DTK 4.06	AMI (April 1990)	AMI 4625-122890-KF	AMI (July 1990)
Setup/password in ROM	■/■	■/❑	❑/■	■/■	■/❑	■/❑	■/❑
System shadowing/video shadowing	■/■	■/■	❑/❑	❑/❑	■/■	■/■	■/■
DISK DRIVES							
Drive bays	2 half-height, 2 3.5-inch	10 half-height	1 half-height, 3 3.5-inch	4 half-height	1 full-height, 2 half-height, 2 3.5-inch	6 half-height, 2 3.5-inch	6 half-height
Controller integrated on motherboard	❑	❑	❑	❑	❑	❑	❑
Hard disk options	426.5MB–1.2GB	44MB–680MB	80MB–320MB	40MB–330MB	40MB–1GB	80MB–1.02GB	40MB–780MB
Minimal floppy disk configuration	1.2MB	1.2MB, 1.44MB	1.44MB	1.2MB	1.2MB or 1.44MB	1.2MB or 1.44MB	1.2MB or 1.44MB
EXPANSION BUS							
Expansion slots:							
8-bit	None	None	None	None	None	None	1 (open)
16-bit	2 (none open)	8 (5 open)	None	7 (5 open)	8 (5 open)	None	7 (4 open)
32-bit EISA/MCA	6 (3 open)	None	4 (3 open)	None	None	8 (5 open)	None
32-bit proprietary	1 (open)	None	None	1 (open)	None	1 (open)	None
Ports originate on motherboard	■ (comm only)	❑	■	❑	❑	❑	❑
Dedicated mouse port	❑	❑	■	❑	❑	■	❑
VIDEO							
Display mode	Super VGA	1,024 by 768	1,024 by 768	Super VGA	Super VGA	1,024 by 768	1,024 by 768
Display circuitry location	Card	Card	Motherboard	Card	Card	Card	Card
Interface	16-bit	16-bit	32-bit	16-bit	16-bit	16-bit	16-bit
Video adapter manufacturer	Mitac	Diamond	IBM	Tseng	Boca Research	Orchid	Orchid
Chip set manufacturer	Western Digital	Tseng	IBM	Tseng	Tseng	Tseng	Tseng
SOFTWARE							
DOS	4.01	3.3, 4.01	4.01 ($155)	3.3, 4.01	4.01	4.01	3.3, 4.01
Other bundled software	None	*Windows* 3.0	None	None	None	None	None
MISCELLANEOUS							
Supports Weitek coprocessor	■	■	❑	■	■	■	■
Keyboard manufacturer	BTC	NTC	IBM	Maxi-Switch	Chicony	Maxi-Switch	Chicony
Power supply (watts)	200	375	194	285	250	250	250
Number of device connectors	4	7	3	3	4	6	4
Keyboard/case lock	Front/front	Front/side	Back/back	Front/none	Front/none	Front/none	Front/none
Power-on/reset switch	Front/front	Back/none	Front/none	Back/front	Front/front	Front/front	Front/front
Warranty	1 year	1 year	1 year	1 year	1 year	1 year	2 years parts, 18 months labor
Service	On-site	Dealer	Dealer, vendor	Vendor, on-site	Phone service	On-site	Vendor
FCC Class B identification number	None	None	ANO8590A	None	None	None	None

PC—Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.
AIR—Advanced Integration Research Inc., AMI—Advanced Megatrends Inc., C&T—Chips and Technologies Inc.
* The 16-bit slot in the NCR Model 3341 is inaccessible when all proprietary slots are filled.

KRIS 48E-2	Master Cascade 48625	Matrix Digital 486/25 ISA	Matrix Digital 486/25 EISA	Mega Impact 486-25	Micro Express ME 486-ISA	National Micro Systems Flash 486	NCR Model 3341	Novas OPTimum 486-25
$9,869	$4,899	$4,615	$5,775	$5,085	$4,299	$4,499	$11,645	$4,045
150MB	200MB	211MB	160MB	339MB	200MB	300MB	340MB	207MB
Dealers	Dealers, direct	Dealers	Dealers	Dealers	Direct	Direct	Dealers, direct	Dealers, direct
EISA	ISA	ISA	EISA	ISA	ISA	ISA	MCA	ISA
Tower	Tower	Desktop	Desktop	Tower	Small-footprint	Tower	Small-footprint	Tower
25.8 x 11 x 17.5	25 x 8 x 16.5	6.5 x 21 x 16.5	6.5 x 21 x 16.5	24.5 x 7.5 x 17.8	7 x 15 x 16.5	16.5 x 6 x 18	6 x 15 x 17	24 x 7.5 x 17
AIR	Micro Pro	Micronics	Micronics	AIR	AIR	AMI	NCR	Novacor
Discrete logic	C&T	C&T	Intel	C&T	Intel	Discrete logic	NCR	OPTi
Interleaved page	Interleaved	Interleaved page	Interleaved page	Page mode	Interleaved page	Page mode	Interleaved	Interleaved
1MB–64MB	1MB–16MB	1MB–16MB	4MB–64MB	1MB–16MB	1MB–16MB	1MB–16MB	4MB–64MB	1MB–16MB
Discrete logic	Discrete logic	Discrete logic	Discrete logic	Discrete logic	Discrete logic	Discrete logic	Discrete logic	OPTi
256K	128K–256K	64K–256K	64K–256K	128K–256K	128K–256K	128K	128K	128K–512K
Phoenix 1.00.04	AMI (August 1990)	Phoenix 1.0.10	Phoenix 1.00.11	AMI DINT 6105	AMI (May 1990)	AMI (1990)	Phoenix 1.02.07	AMI (October 1990)
■/■	■/□	■/□	■/□	■/□	■/□	■/■	■/■	■/□
■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■	■/■
10 half-height	6 half-height	5 half-height	5 half-height	6 half-height	3 half-height, 2 3.5-inch	8 half-height	3 3.5-inch	6 half-height
□	□	□	□	□	□	□	■	□
40MB–780MB	40MB–660MB	106MB–680MB	106MB–680MB	40MB–1GB	40MB–750MB	40MB–660MB	100MB–340MB	40MB–676MB
1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB	1.2MB or 1.44MB	1.2MB or 1.44MB	1.44MB	1.2MB
None	2 (1 open)	None	None	None	None	2 (1 open)	None	None
2 (1 open)	6 (4 open)	8 (5 open)	1 (none open)	8 (4 open)	8 (6 open)	6 (4 open)	1 (open*)	6 (3 open)
6 (5 open)	None	None	7 (4 open)	None	None	None	3 (open)	None
None	None	None	None	None	None	None	5 (3 open)	2 (2 open)
■	□	□	□	□	□	□	■	□
■	□	□	□	□	□	□	■	□
1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768	Super VGA	Super VGA	1,024 by 768	1,024 by 768
Card	Card	Card	Card	Card	Card	Card	Motherboard	Card
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Orchid	TMI	Tseng	Tseng	Mega	Micro Express	Orchid	NCR	Puretek
Tseng	TMI	Tseng	Tseng	Trident	Tseng	Tseng	NCR	Tseng
3.3, 4.01	4.01	4.01 ($73)	4.01 ($73)	3.3, 4.01 ($70)	3.30, 4.01 ($75)	4.01	4.01	4.01
AIR setup software	None	None	None	None	None	None	None	None
■	■	■	■	■	■	■	■	■
Chicony	Northgate	NMB	NMB	NMB	Chicony	Maxi-Switch	NCR	Key Tronic
250	230	220	220	230	200	230	215	275
4	4	4	4	4	4	4	3	6
Front/side	Front/front	Front/front	Front/front	Front/none	Front/none	Front/none	None/front	Front/none
Back/none	Front/front	Side/front	Side/front	Front/front	Front/front	Front/front	Front/none	Front/front
2 years parts, 18 months labor	1 year	1 year	1 year	1 year	2 years	15 months parts, 2 years labor	1 year	1 year system, 2 years parts
On-site	Dealer, vendor	Dealer	Dealer	Dealer	Vendor	Phone service	On-site	Dealer
None	None	None	None	None	GXU309ME486	EJM486S401	C8P3433-25	None

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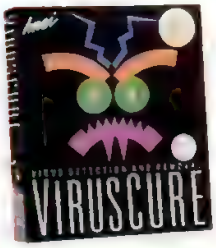

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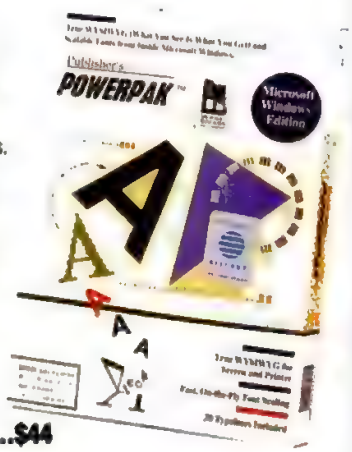

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25-MHz 486-BASED PCs: SUMMARY OF FEATURES

Products listed in alphabetical order by company name

	PC Brand 486/25 ISA	Peregrine 425T	Poly 12/486-25A	Poly 486-25EISA	Reason Square 4	SAI 486/25 ISA	Softworks Citus 486 TS 25I
List price (standard configuration)	$4,368	$4,230	$5,225	$5,625	$3,915	$3,825	$4,595
Standard hard disk capacity	189MB	200MB	200MB	200MB	200MB	200MB	213MB
Distribution channel	Direct	Dealers, direct	Dealers, direct	Dealers, direct	Direct	Direct	Dealers
Bus architecture	ISA	ISA	ISA	EISA	ISA	ISA	ISA
Case type	Desktop	Tower	Tower	Desktop	Small-footprint	Desktop	Tower
Dimensions (HWD, in inches)	6.5 x 16 x 16.8	24 x 7.5 x 16.5	24.5 x 7.5 x 17.5	6.5 x 21 x 16.5	6 x 16 x 15.3	6.3 x 17.5 x 18	25.3 x 7.5 x 16.9
Motherboard manufacturer	PC Brand	Peregrine	Polywell	AIR	Reason	AIR	Softworks
80486 chip set manufacturer	OPTi	OPTi	OPTi	Intel	OPTi	Intel	OPTi
System RAM arrangement	Interleaved page	Interleaved page	Interleaved page	Interleaved page	Interleaved page	Interleaved page	Page mode
MEMORY AND PROCESSOR RAM CACHE							
Installable RAM	1MB–16MB	1MB–16MB	1MB–32MB	1MB–64MB	4MB–16MB	2MB–16MB	1MB–64MB
Cache controller	OPTi	OPTi	OPTi	Intel	OPTi	Discrete logic	OPTi
Installable cache RAM	128K	64K–2MB	64K–512K	64K	128K	128K–256K	64K–128K
BIOS							
BIOS version	MR V1.0C (1990)	AMI (April 1990)	AMI EOBC-6188-101590-KF	Phoenix 1.00.04	AMI (1990)	AMI 0904 (1990)	AMI (October 1990)
Setup/password in ROM	■/■	■/❑	■/❑	■/❑	■/❑	■/❑	■/❑
System shadowing/video shadowing	■/■	■/■	■/■	■/■	■/■	■/■	■/■
DISK DRIVES							
Drive bays	3 half-height, 2 3.5-inch	6 half-height, 2 3.5-inch	6 half-height, 1 3.5-inch	6 half-height	3 half-height, 2 3.5-inch	5 half-height	7 half-height
Controller integrated on motherboard	❑	■	❑	❑	❑	❑	❑
Hard disk options	44MB–640MB	40MB–650MB	100MB–2.5GB	150MB–2.5GB	52MB–676MB	40MB–1.2GB	40MB–1.03GB
Minimal floppy disk configuration	1.2MB or 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB, 1.44MB	1.2MB or 1.44MB	1.2MB or 1.44MB
EXPANSION BUS							
Expansion slots:							
8-bit	1 (open)	2 (1 open)	2 (2 open)	None	None	None	1 (open)
16-bit	6 (4 open)	6 (4 open)	10 (7 open)	None	7 (5 open)	8 (5 open)	7 (4 open)
32-bit EISA/MCA	None	None	None	8 (6 open)	None	None	None
32-bit proprietary	1 (open)	None	None	None	1 (open)	None	None
Ports originate on motherboard	❑	❑	❑	■	❑	❑	❑
Dedicated mouse port	❑	❑	❑	❑	❑	❑	❑
VIDEO							
Display mode	Super VGA	1,024 by 768	VGA	VGA	Super VGA	1,024 by 768	1,024 by 768
Display circuitry location	Card	Card	Card	Card	Card	Card	Card
Interface	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Video adapter manufacturer	Trident	Diamond	Diamond	Diamond	Diamond	Diamond	Softworks
Chip set manufacturer	Trident	Tseng	Tseng	Tseng	Tseng	Tseng	Western Digital
SOFTWARE							
DOS	4.01 ($70)	4.01	3.3, 4.01	3.3, 4.01	4.01	4.01	3.3, 4.01
Other bundled software	None	*Windows* 3.0	None	None	None	*SP Word*	*PC Probe Diagnostics*
MISCELLANEOUS							
Supports Weitek coprocessor	■	■	■	■	■	■	❑
Keyboard manufacturer	M-tech	NMB	Chicony	Chicony	Fujitsu	Focus	Maxi-Switch
Power supply (watts)	200	300	250	220	200	200	220
Number of device connectors	4	5	4	4	4	5	6
Keyboard/case lock	Front/none	Front/none	Front/none	Back/none	Front/none	Front/none	Front/none
Power-on/reset switch	Front/front	Front/front	Front/front	Side/front	Back/front	Side/front	Front/front
Warranty	1 year	1 year	1 year parts, 5 years labor	1 year parts, 5 years labor	2 years	1 year parts, 3 years labor	1 year
Service	Vendor	Vendor, on-site	Dealer, on-site	Dealer, on-site	Phone service	Phone service	On-site
FCC Class B identification number	IH848625D02	None	None	None	None	None	None

PC—Editors' Choice ■—Yes ❑—No
N/A—Not applicable: The product does not have this feature.
AIR—Advanced Integration Research Inc., AMI—Advanced Megatrends Inc., C&T—Chips and Technologies Inc.

Tangent Model 425i	Tangent Model 425e	Tenex 486 Power Column	Touche 5550T/486-25	Touche 5550T/486-25E	Treasure Chest TC 486-25	Ultra-Max 486-25	Unisys PW2 800/486-25A	Zeos 486-25C
$4,084	$6,284	$3,724	$3,949	$4,949	$3,699	$4,545	$14,153	$5,890
207MB	207MB	210MB	200MB	200MB	211MB	200MB	170MB	200MB
Dealers, direct	Dealers, direct	Dealers, direct	Direct	Direct	Direct	Dealers, direct	Dealers, direct	Direct
ISA	EISA	ISA	ISA	EISA	ISA	ISA	ISA	EISA
Mini-tower	Tower	Tower	Tower	Tower	Tower	Desktop	Tower	Tower
15.3 x 8.5 x 16	24.5 x 7.3 x 18	21 x 7.3 x 18.3	26 x 7.5 x 17.5	23.5 x 11 x 17.5	21 x 7.1 x 20	5.8 x 21 x 22.5	21 x 6 x 19	24.5 x 7.5 x 17.5
Dash	Mylex	DTK	AMI	AMI	DTK	Micronics	Intel	Mylex
OPTI	Intel	VLSI Tech	C&T	Intel	Intel	Discrete logic	Intel	Discrete logic
Interleaved page	Interleaved page	Page mode	Page mode	Page mode	Page mode	Page mode	Interleaved	Interleaved page
1MB–32MB	1MB–32MB	1MB–16MB	1MB–16MB	1MB–96MB	1MB–16MB	4MB–16MB	8MB–32MB	1MB–32MB
Discrete logic	Mylex	Discrete logic	Proprietary	AMI	Austek	C&T	None	Discrete logic
128K–512K	128K	64K–256K	128K	64K–256K	64K–256K	64K–256K	N/A	128K
AMI EOBC 6150 (November 1990)	Phoenix 2.00, Mylex EISA 6.02	DTK 486 4.26	AMI (April 1990)	AMI 33235	AMI (April 1990)	Phoenix 0.10F9	Phoenix 1.10	Mylex MAE-486 6.01 (November 1990)
■/❑	■/❑	■/■	■/❑	■/❑	■/❑	❑/❑	■/■	■/❑
■/■	■/■	❑/❑	■/■	■/■	■/■	■/■	■/■	■/■
4 half-height, 1 3.5-inch	6 half-height	5 half-height	3 full-height	10 half-height	6 half-height	5 half-height	5 half-height	6 half-height, 2 3.5-inch
❑	❑	❑	❑	■	❑	❑	■	❑
55MB–1.2GB	105MB–7GB	84MB–676MB	76MB–1470MB	76MB–1470MB	45MB–1 05GB	40MB–541MB	52MB–340MB	42MB–1.1GB
1 2MB	1.2MB	1.2MB or 1.44MB	1.2MB, 1.44MB	1 2MB, 1.44MB	1 2MB or 1 44MB	1.2MB, 1.44MB	1.2MB or 1 44MB	1 2MB or 1 44MB
None	None	1 (open)	1 (none open)	None	2 (2 open)	None	1 (open)	None
8 (6 open)	None	6 (4 open)	6 (4 open)	None	6 (4 open)	8 (5 open)	3 (2 open)	None
None	8 (5 open)	None	None	7 (5 open)	None	None	None	8 (5 open)
None	None	1 (open)	1 (open)	1 (open)	None	None	4 (2 open)	None
❑	❑	❑	❑	❑	❑	❑	❑	❑
❑	❑	❑	❑	❑	❑	❑	❑	❑
Super VGA	Super VGA	Super VGA	1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768	1,024 by 768
Card	Card	Card	Card	Card	Card	Card	Card	Card
16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit	16-bit
Sigma	Sigma	Boca Research	Orchid	Orchid	Orchid	Orchid	Western Digital	Diamond
Tseng/Sierra	Tseng/Edsun	Tseng	Tseng	Tseng	Tseng	Tseng	Paradise	Tseng
4.01 ($89)	4.01 ($89)	4.01	4.01	4.01	3.3, 4.01	4.01	4.01	DOS 4.01
None	None	None	None	None	None	*Windows* 3.0	*Windows* 3.0	*Windows* 3.0 with mouse
■	■	■	■	■	■	■	■	■
Key Tronic	Key Tronic	Chicony	Key Tronic	Key Tronic	Chicony	Fujitsu	Unisys	Zeos
275	270	200	300	475	200	220	302	450
4	8	4	4	6	5	4	5	6
Front/none	Front/none	Front/none	None/front	None/front, side	Front/front	Front/none	Front/front	Front/none
Front/front	Front/front	Front/front	Front/front	Back/none	Front/front	Side/front	Top/front	Front/front
1 year	1 year system, 2 years motherboard	1 year	1 year	1 year	1 year	1 year	1 year	1 year system, 5 years keyboard
On-site	On-site	On-site	On-site	On-site	On-site	On-site	Dealer, vendor	Vendor
II7425I (B-pending)	None	F2825K4FEAT2502	IWB5550T48625I	IWB5550T48625E	F825K4FEAT2502	None	HX2PWAB48601	BYD4864MDT

ENDS

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Both of these machines fall into the high end of the price range, and they are less appealing than computers that can be had for $3,000 less with equal or better performance and characteristics. Furthermore, it seems difficult to justify spending $2,000 more for the EISA machine unless you absolutely need the four extra drive bays and faster hard disk performance.

Within the KRIS line, perhaps the 33-MHz 386 computer has the best price/performance ratio. In the standard configuration the 386/33 costs almost $2,500 less than the 486 25-MHz ISA model, but again, prudent shoppers will find more for less by looking elsewhere.

SOFTWARE DISK CACHE: The Price/Performance Edge

by Bill O'Brien

Disk caches, whether $100 software packages or $1,000 caching disk controllers, improve your computer's performance more dramatically than just about any other enhancement. In most cases, a caching controller will perform about twice as well as a software caching program, such as *PC Kwik*, with the same size cache. But in everyday use, that difference may not be enough to make up for the vast gap in price between the two.

We tested 10 of the 61 systems in this review: 5 uncached PCs from Bus, CSS, Dell, Mega, and Softworks, and 5 systems with hardware caching controllers from American Mitac, Cheetah, Copam, Tangent, and Zeos. Four of the 5 caching computers had Mylex DCE controllers with 1MB of cache and a microprocessor on-board; the Cheetah Gold contained a PSI Hyperstor Model 1600 controller with a 512K cache and a microprocessor.

We ran all 10 machines through the complete arsenal of PC Magazine Labs disk tests: large- and small-record DOS File Access tests and variable file-size tests. All do random and sequential reads and writes with files that can range in size from about 60K to nearly 4MB. Because we're using PCs with a variety of disk controllers (Mylex, PSI, UltraStor, Western Digital, Adaptec) and an equally divergent grouping of hard disks (Micropolis, Maxtor, Quantum, Seagate), the results are not a quantitative declaration of performance as much as they are a glimpse at the overall performance picture from this slice of the 61 computers.

The first set of results was not surprising: All of the systems with hardware cache performed substantially better than the uncached systems. On average, when tested with files smaller than 512K, caching was usually faster by a factor of 15 to 1. The exception here was the Cheetah Gold, which, with its 512K cache, managed only an average 7-to-1 advantage.

With 8MB of system memory to use, we had no compunctions about adding 2MB of software cache to the noncached systems (we used the caching program from Multisoft's *Super PC Kwik Power Pak*, Version 2.0, $130 suggested retail), and that changed our picture drastically.

With files smaller than 512K, *PC Kwik* improved the test results of the Bus, CSS, Dell, Mega, and Softworks systems by about 8 to 1 over their original scores—roughly the same performance level as seen in the Cheetah Gold. The software cache also cut the other hardware cached systems' advantage down to only 2 to 1.

Don't rush out thinking that in all cases, you can save a bundle of cash by investing $100 in caching software and $200 for 2MB of extended memory instead of a $1,000 hardware cache controller. We're reporting an average performance factor. With both hardware and software caches, both sequential and random writes to the hard disk were slower than reads from the disk. But for the software-cached computers, writing took five to ten times as long as reading. For the hardware-cached machines, writing took only three to five times as long as reading at or below the 512K-file level.

Where software did excel was in sheer size. When we filled the 1MB hardware cache controllers, they petered out and performed no better than the software-cached systems. But at the 1MB hardware cache limit, we were using only half of the 2MB software cache we had set up. When we went beyond 1MB file sizes (the point at which the hardware cache was completely exhausted), software caching pushed ahead and was actually two times as fast as its hardware counterpart. And that was accomplished at less than a third the price of hardware caching. Once we went beyond the 2MB boundary, the average disk performance of both cache types evened out again.

While the conclusion is that a hardware cache is faster than a similarly sized software cache, the monetary advantage of a software cache may be more attractive to you. That dollar advantage comes with additional caveats. While the RAM used by software to cache disk data is usually assigned to extended memory, the actual caching algorithm requires some 15K to 20K of conventional memory. Depending upon how many other TSRs you have (mouse, disk, video, and network drivers are included in that list), the software cache may not leave enough conventional memory for you to run any of your programs.

Likewise, if your programs use extended memory, you could find yourself in an ever-escalating RAM upgrade contest as you try to balance how much you need for disk cache versus how much your program needs for itself. Finally, programs like *PC Kwik* operate in the DOS environment only—not with operating systems like *NetWare*. When you run into these barriers, the only effective solution, despite the higher price, is a hardware cache controller.

In future issues of *PC Magazine*, we will supply two sets of disk test results—cached and uncached—when the vendor bundles a disk cache with the system. These numbers will help you get a better idea of how that system will work under both conditions. ■

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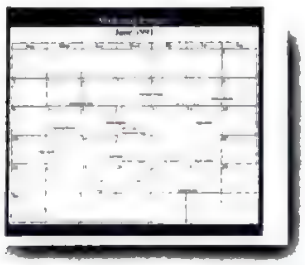

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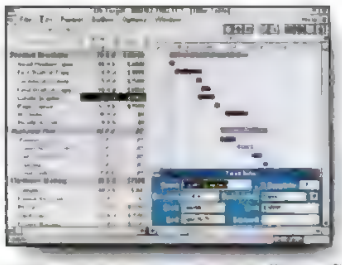

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*PC Magazine, September 25, 1990

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- 4MB of RAM
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- 1.44MB and 1.2MB floppy drives
- 16-bit SVGA Adaptor
- 14"SVGA color monitor
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CIRCLE 207 ON READER SERVICE CARD

MASTER COMPUTER INC.

Cascade 48625

by Kellyn S. Betts

In some ways the Cascade 48625—Master Computer's 25-MHz ISA 486—proves the wisdom of offering upgradeable systems. The fact that the Cascade 48625's processor perches above its motherboard on a separate card adds to the system's versatility.

Despite its position, the processor performed just as well as its motherboard-bound peers in our tests. But you'd expect a machine powered by an add-in processor to be more expensive. In fact, this one is priced competitively, even though it has no processor RAM cache. The $4,899 price tag of *PC Magazine*'s standard system includes 8MB of RAM, a 200MB hard disk, one high-density floppy disk drive, a Super VGA subsystem including a NEC 4D monitor, and a 119-key Northgate OmniKey Plus keyboard. (Master Computer charges $100 more for the second floppy disk drive that came in the machine we tested.)

BETTER DEALS

As for similar machines, Master Computer's 486/33 turns out to be a better deal than either its 486/25 or 386/33 siblings, although its price is still somewhat high for a mail-order machine in its service class. For $5,995—or about 20 percent more—you get a 256K cache and the 25 percent better processor performance associated with the 33-MHz 486.

Master Computer sells via mail order, through dealers and, in the Seattle area, directly. The five-year-old company offers a complete line of Intel-based personal computers including models based around the 80286, 80386, and 80486, all of which come with the industry-standard one-year warranty on parts and labor. Support is provided through toll calls to the company. Returns and repairs must be shipped to Master Computer in Seattle, at the user's expense.

ODDITIES

Oddly, this computer's RAM comes in 1Mb-by-9 DIPs. A good deal of the Micro Pro Technology motherboard's real estate in the system we tested was taken over by banks of sockets designed to hold 8MB worth.

On our tests, the system was able to access the DRAM memory perfectly well, but the system's design would make upgrading a chore if you initially purchased, say, a system with 4MB of RAM. Getting to the system maximum of 16MB requires the use of a card in a proprietary 32-bit slot. Memory upgrades cost $120 per MB. For an 8MB upgrade, including the required card, the cost would be $1,070.

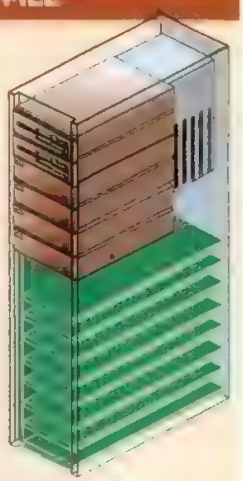
The standard tower case housing the Cascade 48625 allows ample room for the RAM-filled motherboard, as well as eight slots and six half-height drive bays. In the system we reviewed, five slots and three accessible bays were free, and since the machine is designed to be a workstation, the amount of space provided seems sufficient to fill the needs of a single user.

SLOWDOWN

But can the components filling the slots and bays in use also provide solid performance? Although the 15-millisecond Maxtor IDE drive performed acceptably (though not outstandingly), the TMI Super 8900 controlling the video output had the dubious distinction of posting the slowest score by far on our video test. Investigation into the problem showed that the card was unable to take advantage of its 16-bit interface; the end result was that it operated at 8 bits and posted a test time over three times the average. The problem was a function of the card, however, and not the computer: When we placed a TMI Super 8900 with a later ROM revision date in the system, it was able to operate at 16 bits and posted much better results. (The scores came in too late to report, however.)

Although we cannot recommend the purchase of Master Computer's Cascade 48625 based on the model we tested, the company offers other options that you could use to build a better system; you could even start with a 386 model and upgrade. But if you're looking for a high-end system, this company's 486/33 is a better deal.

FACT FILE

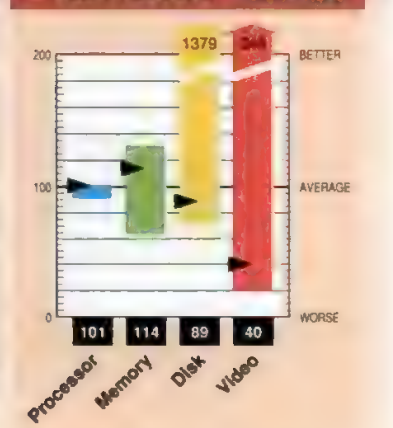


Cascade 48625
Master Computer Inc., 10742 Fifth Ave. NE., Seattle, WA 98125; 206-365-1156.
List price (tested configuration): $4,999.
Memory and processor RAM cache: 8MB 80-ns. DIPs.
Disk drives and controller: Maxtor 15-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: TMI 1,024 by 768 adapter with 1MB RAM, NEC 16-inch monitor.
Software: DOS 4.01.

CIRCLE 406 ON READER SERVICE CARD

CASCADE 48625

TEST RESULTS



In Short: Bogged down by the TMI Super 8900 card performing its video chores, the Cascade 48625 turned in the worst video score in this group of 61 PCs. Despite a quick access speed of 15 milliseconds, the moderately priced ISA system's Maxtor IDE hard disk offered midrange performance. Ironically enough, the best time was posted by the card-bound 25-MHz processor positioned above the upgradable system's motherboard; it had no trouble accessing the motherboard's DIP memory.

MATRIX DIGITAL PRODUCTS INC.

Matrix Digital 486/25 ISA
Matrix Digital 486/25 EISA

by Bruce Brown

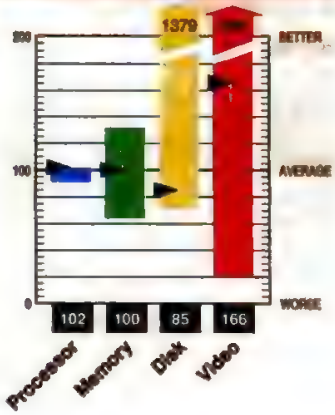
Even when a vendor sells both ISA and EISA versions of similar computers, direct price and performance comparisons are often muddied by differences in motherboard, RAM cache, ROM BIOS, and other components. Occasionally, however, you'll find a vendor whose machines differ only by the actual I/O bus and little else. Since the two Matrix Digital machines in this roundup fall into the fraternal twin category, you can base your buying decision on bus considerations alone.

Matrix Digital has priced both the Matrix Digital 486/25 ISA and the Matrix Digital 486/25 EISA fairly competitively, especially when you figure that most computer dealers' discounting policies can save you anywhere from 15 to 30 percent off list price.

The ISA-bus Matrix Digital 486/25 lists for $4,690 in our standard 8MB configuration, including a 256K RAM cache, a 211MB hard disk, both 1.2MB

MATRIX 486/25 ISA

TEST RESULTS



In Short: The Matrix Digital 486/25 ISA performed within the normal range on all our benchmark tests. The IDE disk's score, slightly slower than average, reflects the different hard disks and controllers. Like its EISA mate, this system is standard fare at a reasonable price.

Wait a minute.

The long modem wait is over. Announcing the arrival of our remarkably quick 9600EX modem.

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Plus, the 9600EX features full-compliance with V.32 and is downward-compatible with slower modems. And, like our entire family of modems, the 9600EX comes with a full, five-year warranty.

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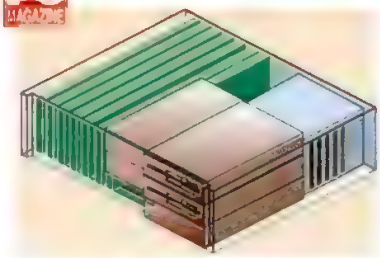

Matrix Digital 486/25 ISA
Matrix Digital Products Inc., 1811 N. Keystone St., Burbank, CA 91504; 800-227-5723, 818-566-8567.
List price (tested configuration): $4,690.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Seagate 15-ms. 211MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Relisys 15-inch monitor.
Software: DOS 4.01.

CIRCLE 409 ON READER SERVICE CARD

and 1.44MB floppy disk drives (standard on all Matrix systems), and a Super VGA display subsystem. The Matrix Digital EISA costs $5,850 for a setup that differs only in the substitution of an ESDI 160MB hard disk and UltraStor caching controller for the ISA's 211MB IDE drive.

In addition to their Micronics motherboards, the two computers had other physical similarities. Both came in a full-sized AT-style desktop case, measuring 6.5 by 21 by 16.5 inches (HWD). Both also had five half-height drive bays (three accessible from the front for removable media), and each had a 220-watt KPI switchable power supply with four power connectors. Each system also came with a standard NMB Hi-Tek 101 key keyboard.

Both machines performed well on our processor, memory, and video tests, although not surprisingly, the EISA version outperformed its ISA counterpart on our disk access tests.

486/25 ISA

The ISA bus version of the Matrix Digital system, referred to as the 486/25 ISA, accepts 1MB to 16MB of 80-nanosecond SIMM RAM, all on the motherboard. The direct-mapped 256K external RAM cache uses 25-ns. SRAM DIPs.

The system board has eight full-length, 16-bit expansion slots. Five slots were free on our test machine; three were taken up by I/O, video, and drive interface cards. The system comes with a 211MB 15-millisecond Seagate IDE hard disk.

Matrix Digital Products sells both 386/33 and 486/33 ISA PCs, each of which can be equipped identically to the 25-MHz 486 version reviewed here. The 386/33 costs $840 less than the 486/25, which is a significant drop relative to the overall system price. To go from the 25-MHz 486 to the 33-MHz, however, costs only an additional $375—an appealing price differential for the CPU performance gain.

486/25 EISA

The EISA version of the 486/25 differs in memory capacity and I/O slots from its ISA sibling. You can install a minimum of 4MB RAM and a maximum of 64MB on the motherboard, all in 80-ns. SIMMs. The EISA system's RAM cache architecture is the same as that of the ISA's.

Just a second.

All of this becomes even more remarkable when you consider the price of the 9600EX. Just $799. It's a price, in fact, that rivals high-end 2400 modems. It's also an example of Intel's commitment to affordable quality.

For more information, call 800-538-3373. Or for information faxed to you, call 800-525-3019 and request Doc.#9986. But don't wait, because with all the 9600EX offers, it will go in a second.

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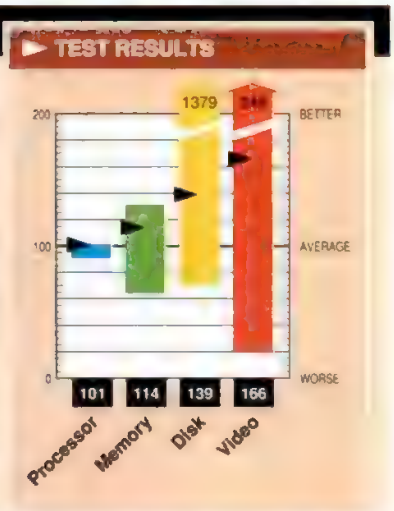
CIRCLE 749 ON READER SERVICE CARD

MATRIX 486/25 EISA



In Short: The Matrix Digital 486/25 EISA's somewhat faster-than-average disk test score can be attributed to the 512K caching disk controller, used in conjunction with a 16-millisecond ESDI hard disk. Like the ISA version, the EISA model achieved processor, memory, and video scores on the fast side of the normal range. Largely because of the caching controller, you can expect to pay about $1,000 more for the EISA system.

The Micronics EISA motherboard has one 16-bit ISA slot and seven 32-bit EISA slots. Four slots were left free on our test machine after one slot each was used for video, I/O, floppy disk drive controller, and the UltraStor ESDI hard disk controller (with 512K drive cache for the 160MB 16.5-millisecond Seagate hard disk). You can save a slot by opting instead for a combined floppy/hard disk drive controller.

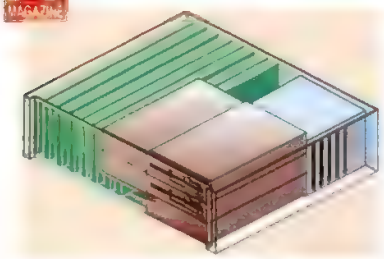
To go from the 486/25 test EISA system to a 486/33 EISA costs an additional $588, a greater price jump for the faster processor speed than with Matrix Digital's ISA machines. EISA commands a premium, but it's still probably worth it for the faster CPU if overall system speed is a high priority.

Since Matrix Digital systems are sold only through dealers, the dealer is the primary service provider. The warranty lasts for one year and covers parts and labor costs. An on-site service contract via Nationwide Service is available for these systems, again sold only through the dealer. If you want to talk directly with the manufacturer, Matrix Digital does maintain a toll-free technical support line that operates during normal business hours, P.S.T.

SAFE BET

The two Matrix Digital systems are both fine computers, using standard components and selling at reasonable prices. These two boxes contain what you'd expect, work as you'd expect, and are priced about where they should be—though maybe a little bit more. If you want to buy a 25-MHz 486 system from a dealer but don't want to pay the premium for a big name, either of these Matrix systems should be a safe bet.

FACT FILE



Matrix Digital 486/25 EISA
Matrix Digital Products Inc., 1811 N. Keystone St., Burbank, CA 91504; 800-227-5723, 818-566-8567.
List price (tested configuration): $5,850.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Seagate 16.5-ms. 160MB ESDI; UltraStor controller, 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Relisys 15-inch monitor.
Software: DOS 4.01.

CIRCLE 410 ON READER SERVICE CARD

MEGA COMPUTER CORP.

Impact 486-25

by John R. Quain

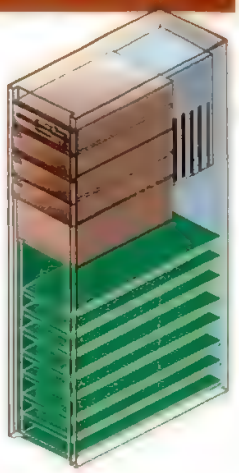
The worst feeling you can get after unpacking a new PC is that something's missing. Unfortunately, Mega Computer Corp.'s Impact 486-25 leaves you with just that impression. With its threadbare documentation, unremarkable capabilities, and poor video times, this system won't create much of a stir.

In our standard configuration, the Impact 486-25 costs $5,065. It comes with 8MB of RAM (expandable to 16MB) on an AIR motherboard; 16 SIMM sockets enable it to handle cheaper 1MB modules (4MB upgrades from Mega are $265 in the 1MB form factor). The Impact 486-25 has an AMI BIOS with video and system BIOS shadowing (both can be disabled through setup) and 128K of Discrete 25-nanosecond external SRAM caching. It can accommodate a Weitek 4167 coprocessor. Our test system arrived with a 339MB Micropolis 15-millisecond hard disk, a 16-bit Adaptec SCSI controller, and one 1.2MB floppy disk drive.

MISSING PIECES

Outside, the Impact case itself was unexceptional, though the sliding plastic cover intended to prevent users from inadvertently shutting off the power kept drop-

FACT FILE



Impact 486-25
Mega Computer Corp., 16980 Via Tazon, #120-170, San Diego, CA 92127; 619-487-8888.
List price (tested configuration): $5,065.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Micropolis 15-ms. 339MB SCSI, Adaptec controller, 1.2MB floppy disk drive.
Display: Sea Star 512K 1,024 by 768 adapter, Mega 14-inch monitor.
Software: DOS 4.01.

CIRCLE 411 ON READER SERVICE CARD

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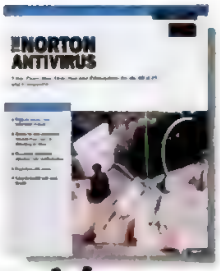

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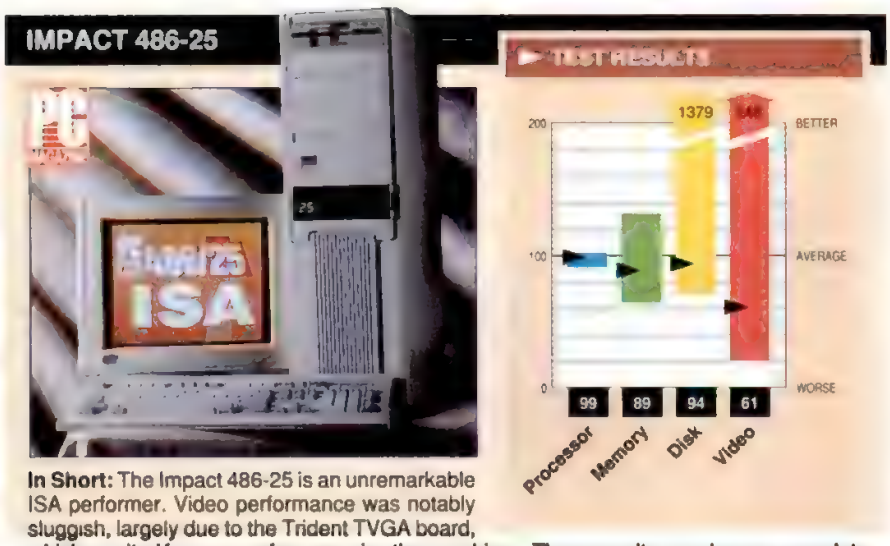
IMPACT 486-25



In Short: The Impact 486-25 is an unremarkable ISA performer. Video performance was notably sluggish, largely due to the Trident TVGA board, which we cited for poor performance in other machines. These results—and a near-complete lack of documentation—eliminate the possibility of using this $5,065 computer as a CAD workstation.

ping back down over the front-panel power and reset buttons. Inside, all cables were properly secured to allow unobstructed access to the system board. In our standard configuration, there were only four free expansion slots. However, there were ten connector cutouts in the back of the case; hence the cables for the LPT1 and game ports, which blocked an expansion slot on our system, could be strung over and out of the slot's way.

In terms of brute performance, the Impact 486-25 fell a little behind the leaders in the Instruction Mix and Conventional Memory scores, slightly hampered by the system's slower page-mode 80-ns. DRAM arrangement. Otherwise, test results proved unremarkable, except for rather poor video performance. The culprit proved to be the 512K DRAM Trident TVGA board, which was cited for poor performance in other machines. The video performance results should pretty much eliminate this Impact from any CAD user's shopping list.

Users must return Mega computers to the dealer for service and repair. The company's PCs are covered by a standard one-year parts-and-labor warranty. If you're still interested in considering this company for a 486 machine, Mega sells an identically configured 33-MHz EISA system for $7,600—a relative bargain for that platform. But as for our experience with the Mega Impact 486-25 ISA, it's a hard machine to recommend.

MICRO EXPRESS

Micro Express ME 486-ISA

by Bruce Brown

Size and price are the major attractions of Micro Express's ME 486-ISA. This FCC Class B–rated 25-MHz system comes in a small-footprint case and is a good performer. Competitively priced—although not exactly cheap—the ME 486-ISA lacks only a standard on-site service contract to get an unqualified recommendation.

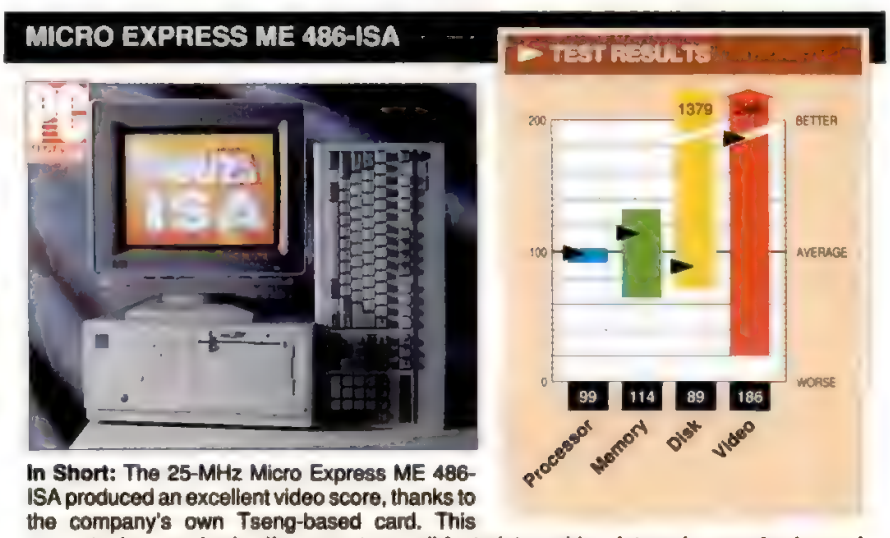
PC Magazine's standard configuration ME 486-ISA system costs $4,299. This price includes 8MB RAM (expandable to 16MB on the motherboard), 256K processor RAM cache, a 200MB hard disk drive, a 1.2MB or 1.44MB floppy disk drive, and a Super VGA subsystem. Our test system arrived with two floppy disk drives for an additional $100. The 486-ISA's case measures 7 by 15 by 16.5 inches (HWD).

There are six full-length 16-bit ISA expansion slots and two half-length slots whose size is limited by the 16-millisecond Maxtor IDE hard disk drive's cage. The test system had six free slots; it allowed room for three half-height 5.25-inch drives and two 3.5-inch drives. All but one of the 3.5-inch drives were accessible.

The 486-ISA's AIR motherboard uses an Intel chip set and an AMI ROM BIOS. All system RAM (using 80-nanosecond SIMMs) is plugged directly into SIMM sockets on the motherboard. There is also a socket for a 25-MHz Weitek math coprocessor. The 256K four-way associative external RAM cache takes 35-ns. SRAM chips.

The Micro Express ME 486-ISA performed well on all our performance tests and did exceptionally well on our video tests. This was due primarily to Micro Express's own high-performance 1MB Enhanced VGA video card, which drove a CTX Super VGA 14-inch color monitor.

MICRO EXPRESS ME 486-ISA



In Short: The 25-MHz Micro Express ME 486-ISA produced an excellent video score, thanks to the company's own Tseng-based card. This computer is a good value if you want a small-footprint machine. Internal expansion is good, given the case size, with room for up to five drives. The FCC Class B rating is another plus, particularly in the light of the system's low price. But without an on-site service option, this mail-order system may not be the ultimate choice.

This is what the world's most powerful 486 system looks like.

ETMS,™ Everex Thermal Management System, makes this the first system to solve the high temperature and related reliability problems of current and future processors. A partition separates the cube into two compartments, independently cooled by SmartFans.™ One contains the CPU, one the drives. Baffles funnel cool air where it's most needed. Even the power supply is cool, because at 400 watts, it runs at a fraction of its capacity.

Cylindrical pin and tumbler locks keep unauthorized fingers out of the hardware. (And your data is equally safe, because we've built password protection into the firmware.)

Removable motherboard for instant upgrades, which we'll bring you as new technologies emerge.

All the full-length expansion slots you'll ever need—12 altogether, including 10 EISA slots. The cube is also available in 8 slot ISA configurations.

AMMA, a 256KB write-back caching architecture, forming "two-tier" caching in combination with the 486 chip's 8KB internal cache. It improves the cache hit ratio from 90% to as much as 99%.

Space for four quick release, half-height drives. They're front accessible, behind a hydraulically dampened door—which makes sure your drive heads are reading disks and tapes, not dust, smoke and humidity.

The entire interior of the cube is accessible in seconds through side panels, using thumbscrews.

The 486/33 CPU chip, Intel's hottest. But when hotter chips come around, the cube will be cool enough to handle them. And that includes multiprocessors.

Quick release drive bays accommodate up to four more drives that can be swapped out in less than five minutes.

And this is why.

Conventional system design can't cope anymore. The emerging technology is just too hot for it.

Enter the STEP Megacube.™ Designed from the ground up, the STEP Megacube is a 486™ system unlike any other. It incorporates ideas from the mainframe world, such as its caching architecture and thermal management. And it has performance and features that make it a perfect fileserver. Or a perfect multiuser system. Or a perfect graphics workstation.

A 486/33 CPU combined with Everex's proprietary Advanced Memory Management Architecture (AMMA™) gives it warp speed—20.8 MIPS. Space for eight drives gives it storage that will remind you of the Library of Congress. And twelve expansion slots give it more expandability than you can shake a peripheral at.

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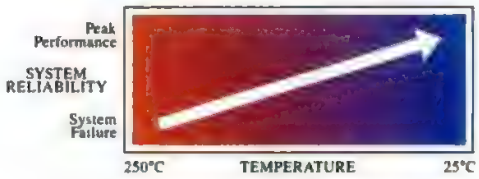

The Everex Thermal Management System (ETMS) improves system reliability by reducing internal temperatures.

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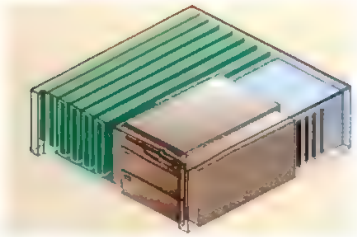


Micro Express ME 486-ISA
Micro Express, 1801 Carnegie Ave., Santa Ana, CA 92705; 800-642-7621, 714-852-1400.
List price (tested configuration): $4,399.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Maxtor 16-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Micro Express Extended VGA adapter with 1MB RAM, CTX 14-inch monitor.
Software: DOS 4.01.

CIRCLE 412 ON READER SERVICE CARD

OPTIONS, OPTIONS

If you're a regular reader of these pages, you know that Micro Express sells computers on every performance platform. ME's 486/25 ISA-bus system is priced about midway between its 386/33 and 486/33 systems, comparably equipped. With the same peripheral setup, a 386/33 Micro Express system sells for $3,799. On the other hand, an even $5,000 buys you a comparably configured 486/33.

Micro Express sells only via mail order and includes a 30-day money-back guarantee with all systems. Before shipment all systems are burned in for 72 hours to lessen the chances of DOA components. ME offers a two-year parts-and-labor warranty standard, plus technical service via telephone with overnight parts shipping for defective parts.

There is no on-site service contract available. If you and the company's technicians cannot solve a problem over the phone, you have to ship the system back to Micro Express's California facility. ME has eased the expense of system shipping by paying for shipping costs both ways during the first four months of ownership; after that, ME pays only for return shipping. However, the aggravation of packing up the system and waiting for it to be shipped back and forth—and possibly suffering damage during transportation—argues strongly against this form of system repair.

If you're looking for a compact speedster, the Micro Express ME 486-ISA offers the right components and ample room for expansion—all at an attractive price. If it weren't for the specter of packing up and shipping a system back to the company for repair, all would be rosy. This computer is a good enough deal that it might be worth your while to purchase an after-market on-site service contract on your own, but it would be even better if Micro Express included it.

NATIONAL MICRO SYSTEMS INC.

Flash 486

by Bill O'Brien

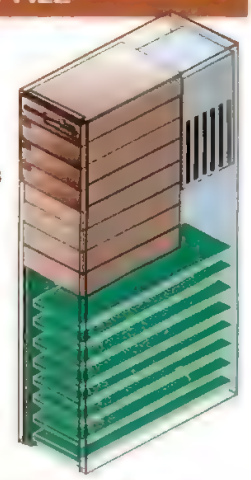
National Micro Systems' Flash 486/25 won't spoil this company's excellent track record. You'll find this ISA-bus PC a capable addition to your office or home.

In *PC Magazine*'s standard configuration, the Flash 486/25 came with 8MB of RAM, a 128K processor RAM cache, a 300MB hard disk drive, a 1.2MB floppy disk drive, and a Super VGA video subsystem. That's an impressive list of components, and it carries an impressively low $4,499 price tag.

The Flash 486 is housed in a 16.5- by 6- by 18-inch (HWD) tower enclosure with eight half-height drive bays. Three bays were occupied in our test system by the floppy disk drive and the full-height hard disk. Three of the remaining bays are accessible. National Micro Systems has included a 230-watt DVE power supply that should prove ample for a Flash 486/25 used as a personal computer. The added power drain of network additions in a server setup might require more juice.

The PC has an AMI Voyager motherboard that uses discrete components instead of a large-scale integrated 80486 chip set. It is Weitek 4167 compatible, expandable to 16MB using 1MB 80-ns.

FACT FILE

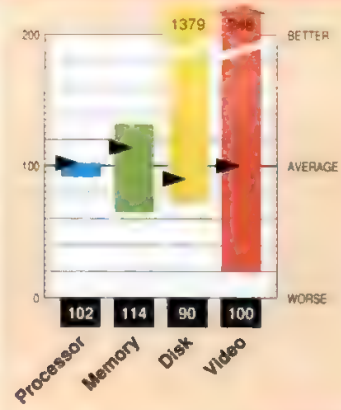


Flash 486
National Micro Systems Inc., 2833 Peterson Pl., Norcross, GA 30071; 800-642-7649, 404-446-0520.
List price (tested configuration): $4,499.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Seagate 14-ms. 300MB ESDI, UltraStor controller, 1.2MB floppy disk drive.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, SuperSync 14-inch monitor.
Software: DOS 4.01.

CIRCLE 413 ON READER SERVICE CARD

FLASH 486

TEST RESULTS



In Short: The Flash 486's ESDI hard disk and its controller performed about average for a non-cached ISA system, and the video score fell a bit short of expectations. But processor and memory performance are both on the mark. The $500 difference between the 386/33 version and this 25-MHz 486 is well spent, although if you are looking for a file server, you should consider a move up to the 33-MHz 486 system.

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SIMMs, and its BIOS is by AMI. Five 8-MHz ISA slots remain after the hard disk controller, I/O card, and video board are installed. This tower configuration allows access to all portions of the motherboard.

If you think it sounds like nothing's missing, you're only partially right. The Flash 486/25 does lack anything that could possibly be called user documentation. NMS includes the requisite amount of technical data, especially in the AMI Voyager motherboard manual, but this documentation is mostly a guide to configuring and assembling an operable computer, not how to get the assembled machine to do what you want.

PERFORMANCE

From a performance standpoint, the Flash 486/25 computer rates about average, which is nothing to sneeze at in this group. The Flash 486/25 produced competitive results to other machines equipped both with and without external cache on PC Magazine Labs processor and memory tests.

The Seagate hard disk, coupled to an UltraStor controller with a 32K ring buffer hard disk, produced mediocre performance—especially for an ESDI drive. Although the controller's ring loop buffer should not be compared with disk cache RAM (it's used to stabilize the relatively fast flow of data from the hard disk into the slower bus), still the Flash 486/25 fell slightly below the average of all drives tested and a goodly distance behind the faster of the tested noncaching disk drives.

MIXED BAG

NMS's service policies amount to a mixed bag. There's no on-site option, though National Micro Systems warrants the Flash 486/25 for 15 months on all parts and two years for labor. The length of the warranty is better than average, but NMS indicated that repairs of its PCs are accomplished by returning the system to the manufacturer. Two years of keeping the packing material might be too much for some users.

About $500 separates National Micro System's 386/33 and the faster 486/33 from the Flash 486/25. The 486/33's processor might give you an increase in speed matching its increase in price—about 20 percent—and it would make a better file server. The Flash 486/25's intrinsic system functions (excluding disk and video) are appreciably faster than those of the Flash 386/33, and the difference would be noticeable. In this case either the 486/25 or 486/33 would make good buys, depending on your need for speed.

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NCR CORP.

NCR Model 3341

by Patrick Honan

Perhaps the best way to see who the 3341 is for is to eliminate the rest. Users in small and midsize businesses probably won't be able to buy in sufficient volume to reduce the high list price significantly. Those committed to the ISA or EISA bus will also bypass the 3341. And those who need room for more than three storage

devices will opt for another system. That leaves corporate customers committed to MCA—but not to IBM—who have deep pockets and light storage needs.

At $11,645 for a system in our standard configuration (including a 200MB hard disk and Super VGA display), the Model 3341 is among the most expensive systems in this review—even if you factor in a 25 percent dealer discount. NCR stocked our test unit with an error-detecting and correcting (EDAC) RAM and a 340MB SCSI hard disk, which boosted the list price to $14,545.

NCR doesn't offer a 33-MHz 386 computer, but a similarly configured 33-MHz 486 machine jumps in price to $18,894. Softening the blow to your wallet is the fact that the 3341, sold through retailers and NCR's direct sales force, is commonly discounted 20 to 45 percent depending on the number of systems a company buys.

SMALL-FOOTPRINT WOES

The small footprint looks nice on a desk, but it severely constrains the machine's value as a workstation. There are just three 3.5-inch drive bays, two of which are accessible. Our test unit had one 3.5-inch floppy disk drive and a 3.5-inch hard disk installed, leaving one accessible bay open.

The largest hard disk NCR offers is the 340MB Maxtor drive in the tested unit. You can get an impressive 680MB of hard disk storage by installing two of these drives, but that leaves you with no free bay to add a tape backup unit or second floppy disk drive.

NCR acknowledges the problem and is considering a change to the 3341's internal layout that would enable you to install a half-height drive in the one bay not accessible from the front. According to an NCR official, this change would not alter the 3341's external dimensions; however, it would not add any more drive bays.

NO MEMORY CONSTRAINTS

There's no such constraint on the amount of RAM. The 3341 holds a maximum of 64MB RAM, well beyond the 16MB most ISA systems support, and more than IBM's maximum memory capacity. All memory

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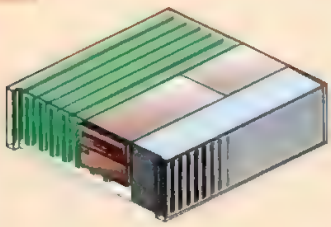

NCR Model 3341
NCR Corp., 1601 S. Main St., Dayton, OH 45479; 800-225-5627, 513-445-6160.
List price (tested configuration): $14,545.
Memory and processor RAM cache: 8MB 80-ns. DIPs.
Disk drives and controller: Maxtor 15-ms. 340MB SCSI, NCR controller, 1.44MB floppy disk drive.
Display: NCR Super VGA adapter with 1MB RAM, NEC 14-inch monitor.
Software: DOS 4.01.

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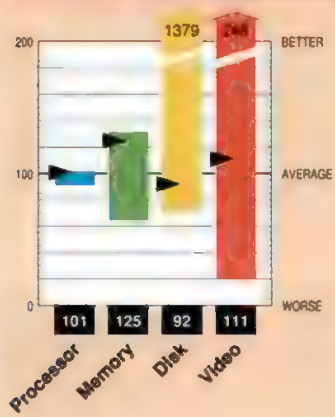
NCR MODEL 3341

TEST RESULTS



In Short: The NCR Model 3341, a small-footprint MCA workstation, produced a slightly above-average processor test score and had the second-fastest time on our memory test. The video circuitry (mounted on the NCR motherboard) and the hard disk showed mid-pack results. NCR offers no RAM cache beyond the cache built into the 80486 processor, and its disk controller is uncached. The main drawback, however, is its room for only three 3.5-inch devices.

> Sporting an FCC Class B rating, a small footprint, and competitive speed, the NCR Model 3341 makes for an intriguing home PC.

is added on memory boards to four proprietary 32-bit slots. The 80-nanosecond memory uses a dual-ported design that lets it communicate with the processor and other peripherals at the same time. This is useful, according to NCR, when multitasking or when using peripherals that take advantage of MCA's bus master support.

In addition to the memory slots, there are three 32-bit and one 16-bit MCA slots; however, because of the board's layout, if you want to use the 16-bit slot you must give up one of the memory slots. (Most users won't require the maximum RAM, so this should not cause much concern.) A ninth slot is dedicated solely to the SCSI controller. Memory boards occupied two 32-bit memory slots in our test machine; the SCSI controller filled the dedicated SCSI slot. Video and I/O ports are integrated onto the motherboard, leaving all four MCA slots and two memory slots open for business.

STRONG PERFORMANCE

The 3341 holds its own in benchmark tests, even though it has no RAM cache beyond the 8K built into Intel's 80486 processor and no caching on the SCSI hard disk controller. Its EDAC RAM turned in slightly above-average Instruction Mix test scores and tied for the fastest time in the Conventional Memory test, though neither score was significantly greater than the norm. The NCR video integrated on the motherboard yielded a slightly below-average video score. The system's SCSI controller and Maxtor 15-millisecond 340MB hard disk placed in the top half of the pack.

Our test unit also came with a still rare FCC Class B certification, which means the small footprint and competitive speed of the 3341 make it an intriguing home system for engineers, programmers, and others who can use the power of the 486 processor.

NCR provides a one-year warranty on parts and labor and one year of free on-site service. There's no central toll-free technical support line offered, but users can call an NCR district office for support.

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Seagate ST251-1 40MB, 28ms, MFM, HH	219	224	265
Seagate ST277R-1 65MB, 28ms, RLL, HH	249	254	289
Seagate ST296N 80MB, 28ms, SCSI, HH	319	324	369
Seagate ST4096 80MB, 28ms, MFM, FH	489	494	529
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Seagate/Imprimis ST2383E 337MB, 16ms, ESDI, HH	1295	INQUIRE	
Seagate/Imprimis ST2383N 338MB, 16ms, SCSI, HH	1325	INQUIRE	
Seagate/Imprimis ST4766E 676MB, 16ms, ESDI, FH	1679	INQUIRE	
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K/Lok KL 330 30MB, 40ms, RLL, HH	159	164	209
Seagate ST138R 30MB 40ms, RLL, HH	219	224	265
Seagate ST157R 50MB, 28ms, RLL, HH	239	243	283
Seagate/Imprimis ST1100 88MB, 15ms, MFM, HH	599	605	647
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You see, Microsoft Windows applications make it possible to do incredible things on-screen, while the HP® LaserJet III family lets you print them in all their glory.

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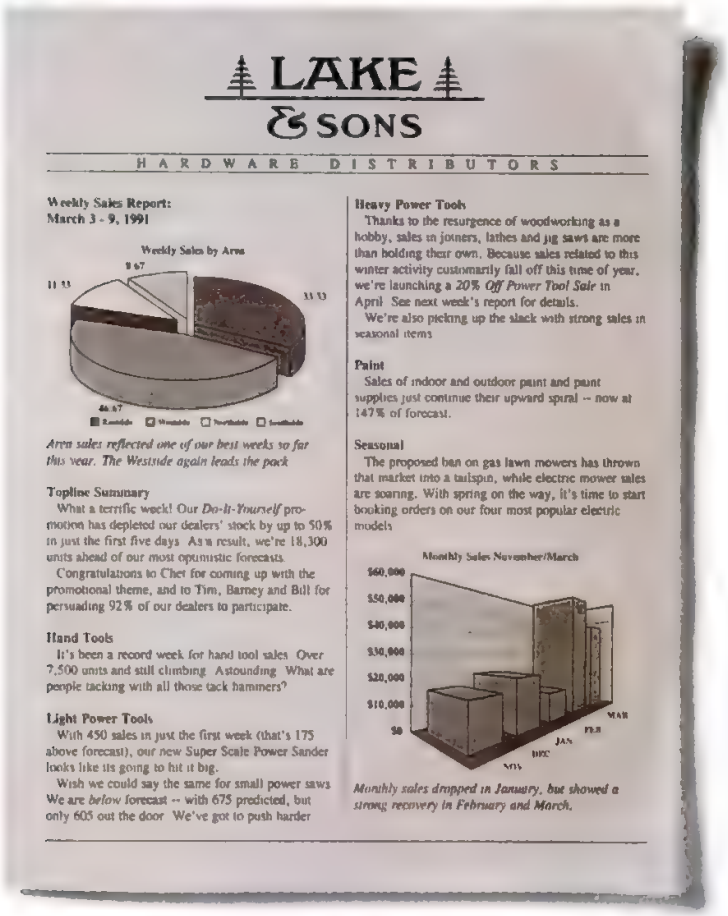
For more information in the 50 United States, call (800) 541-1261, Dept. Q18. In Canada, call (416) 568-3503. Outside the U.S. and Canada, call (206) 936-8661. *© 1991 Microsoft Corporation. All rights reserved. Microsoft and the Microsoft logo*

And everybody else.



LAKE & SONS

HARDWARE DISTRIBUTORS

Weekly Sales Report:
March 3 - 9, 1991

Weekly Sales by Area

Area sales reflected one of our best weeks so far this year. The Westside again leads the pack

Topline Summary

What a terrific week! Our *Do-It-Yourself* promotion has depleted our dealers' stock by up to 50% in just the first five days. As a result, we're 18,300 units ahead of our most optimistic forecasts.

Congratulations to Chet for coming up with the promotional theme, and to Tim, Barney and Bill for persuading 92% of our dealers to participate.

Hand Tools

It's been a record week for hand tool sales. Over 7,500 units and still climbing. Astounding. What are people tacking with all those tack hammers?

Light Power Tools

With 450 sales in just the first week (that's 175 above forecast), our new Super Scale Power Sander looks like its going to hit it big.

Wish we could say the same for small power saws. We are *below* forecast -- with 675 predicted, but only 605 out the door. We've got to push harder.

Heavy Power Tools

Thanks to the resurgence of woodworking as a hobby, sales in joiners, lathes and jig saws are more than holding their own. Because sales related to this winter activity customarily fall off this time of year, we're launching a *20% Off Power Tool Sale* in April. See next week's report for details.

We're also picking up the slack with strong sales in seasonal items.

Paint

Sales of indoor and outdoor paint and paint supplies just continue their upward spiral -- now at 147% of forecast.

Seasonal

The proposed ban on gas lawn mowers has thrown that market into a tailspin, while electric mower sales are soaring. With spring on the way, it's time to start booking orders on our four most popular electric models.

Monthly Sales November/March

$60,000
$50,000
$40,000
$30,000
$20,000
$10,000
$0
NOV
DEC
JAN
FEB
MAR

Monthly sales dropped in January, but showed a strong recovery in February and March.

(This impression courtesy of the Hewlett-Packard LaserJet III printer.)

The Hewlett-Packard LaserJet III family of printers. The perfect companion to Microsoft Windows applications.

comes with scalable fonts supported by our Windows applications. So you get thousands of font choices. As well as the ability to print in record speed. And to ensure that you get crisp, clear output, HP developed a new technology they call Resolution Enhancement™. But you'll call it simply amazing.

To learn more about how Microsoft Windows applications and the HP LaserJet III family uniquely work together, call (800) 541-1261, Department. Q18.

We think you'll be impressed.

HEWLETT PACKARD

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NOVACOR INC.

Novas OPTimum 486-25

by Patrick Honan

Ordinarily you wouldn't treat a 486 computer as an impulse buy, but the price and features of the ISA-bus Novas OPTimum 486-25 could easily tempt you to.

The $4,110 tested-configuration price (which includes an extra floppy disk drive and adds $65 to the standard configuration price) gives you a fully loaded system that includes 8MB of RAM, a 128K RAM cache, a 207MB hard disk, two floppy disk drives, and a 1,024-by-768 video board and monitor. The same configuration with a 33-MHz 486 processor is available for just $500 more. If you can give up some speed, Novacor sells a 33-MHz 386 model in the same configuration—except for a 64K RAM cache—for just $3,495.

Considering this price, those shopping for a 486 computer to use at home are probably salivating. Unfortunately, the tested unit lacked the FCC Class B certification needed to make it eligible for home use.

SACRIFICING SOME AMENITIES

Of course, you do sacrifice some amenities at such a low price. The user manual is a stapled pamphlet that lacks such helpful touches as a troubleshooting guide and index. No on-site service is included in the purchase price, and the technical support line is a toll call with limited hours of 8:30 to 3:30 P.S.T., Monday through Friday.

On a stronger note, you sacrifice little or nothing in terms of quality, expandability, and speed. Components are from proven third-party manufacturers and include an AMI BIOS, an OPTi chip set, a Conner hard disk, TEAC floppy disk drives, and a Sony monitor.

The OPTimum 486-25 has six half-height drive bays, all accessible from the front of the machine. In addition to the 207MB IDE hard disk in the tested unit, Novacor offers a variety of other IDE and ESDI hard disks ranging in capacity from 40MB ($240) to 670MB ($1,403). Two 32-bit and six 16-bit slots are available for expansion boards. One of the 32-bit slots is for a proprietary memory board but also works with standard 16-bit expansion boards. The other 32-bit slot accepts a board that contains the machine's RAM cache. If the cache is not installed, this slot will accept standard 8-bit expansion boards.

Our tested unit's memory comprised eight 1MB 80-nanosecond SIMMs. An additional 8MB memory board can be plugged into one of the 32-bit slots, boosting the system's RAM maximum to 16MB. At the time of the review, Novacor was readying a new motherboard design, including a new revision of the OPTi chip set that would enable you to install up to 40MB of RAM using 4MB SIMMs. The 128K processor RAM cache consisted of 25-ns. static RAM chips; 256K and 512K options are also available.

AVERAGE PERFORMANCE

The OPTimum 486-25 was a middle-of-the-road performer on our benchmark tests. Its worst score was on the DOS File Access test, where the 16-millisecond Conner hard disk was one of several drives to turn in a time of more than 60 seconds. The OPTimum 486-25 tied with more than a dozen other systems for the third-fastest time on the Conventional Memory test; it had slightly above-average times on the 80486 Instruction Mix and Direct to Screen tests.

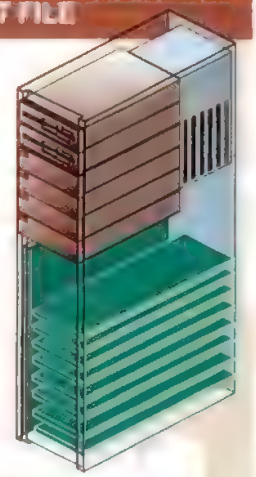
Puretek, the video board manufacturer, is not a well-known name, but its board uses the popular Tseng Laboratories chip set and supports noninterlaced 1,024-by-768 resolution.

PARTS SHIPPING

Although telephone support hours are limited and the call is not toll-free, Novacor ships replacement parts via UPS Blue without waiting for the failed parts to arrive. A standard one-year warranty on parts and labor covers the system except for the motherboard, which is covered by a two-year parts warranty.

The Novas OPTimum 486-25 breaks

FACT FILE

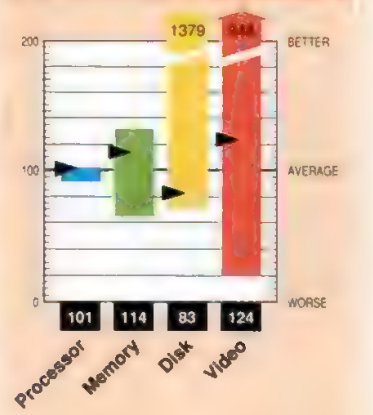


Novas OPTimum 486-25
Novacor Inc., 1841 Zanker Rd., San Jose, CA 95112; 800-486-6682, 408-441-6500.
List price (tested configuration): $4,110.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Conner 16-ms. 207MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Puretek 1,024 by 768 adapter with 1MB RAM, Sony 14-inch monitor.
Software: DOS 4.01.

CIRCLE 415 ON READER SERVICE CARD

NOVAS OPTIMUM

TEST RESULTS



In Short: The highlight of the Novas OPTimum 486-25 is its $4,110 price in our tested configuration—not its innovation or extraordinary speed. Processor speed was above average, though the 16-millisecond Conner hard disk turned in one of the slower disk test times. Factor in average expandability (for a tower), plus the lack of an on-site service option, and not much distinguishes this system from the crowd.

no new technological ground nor sets any records for speed, but its workmanship and performance are good. Couple these observations with the 486-25's very low price and you have a system that deserves a close look.

PC BRAND INC.

PC Brand 486/25 ISA

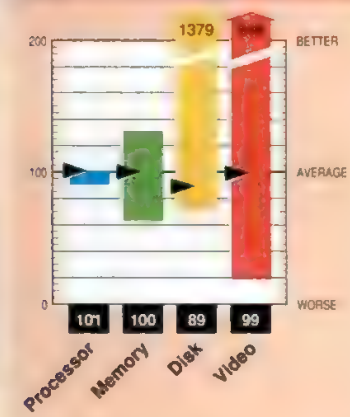
by Bill O'Brien

PC Brand's long history in the IBM-compatibles field has given it a lot of expertise at filling metal boxes with computer components. This company offers a finely tuned pricing ramp up to 80486 technology.

For example, *PC Magazine*'s standard configuration of PC Brand's 486/25 ISA, with a 200MB hard disk and a Trident VGA card driving a CTX color monitor, tips the scales at a competitive $4,368. Our test system held a second floppy disk drive ($75 more) and 128K of external processor RAM cache, which added another $249.

With the price at $4,692 for the computer we tested, you can debate the necessity of the optional external processor RAM cache—especially since none of the machines supplied without an external RAM cache fared badly in PC Magazine Labs processor and memory tests.

PC BRAND 486/25



In Short: PC Brand has not created a performance monster with its 486/25 ISA. Processor, memory, disk, and video test results reveal a stable machine, with the same shortcomings in hard disk performance that other IDE-equipped 486s have. In PC Brand's favor, the company has added a comprehensive service package, and that is often more important than world-beater performance.

The 486/25 ISA's standard enclosure is an almost full-sized desktop case. Three half-height bays are front accessible, and two of these in the reviewed machine were filled with the dual floppy disk drives. Space for two internal 3.5-inch devices is also available, and one of these bays was taken by the Maxtor LXT-200A IDE hard disk.

As with many of the i486 systems, the IDE drive is a compromise between performance and price. Tendering somewhat worse-than-average results in the PC Labs disk tests, the obvious drive of choice in a 486 environment is an ESDI or SCSI model. PC Brand lists a 320MB drive among its ESDI options for an additional $810. Even with the added expense, the system's price is still commensurate with its performance.

PC Brand uses it own motherboard and an OPTi chip set. The motherboard contains 16 SIMM slots for 16MB of system memory as well as a proprietary 32-bit expansion slot used, according to PC Brand, for the 128K-maximum RAM cache expansion card. Of the seven remaining slots, one is an 8-bit and the others are all 16-bit. The Trident VGA card uses one 16-bit slot; a combination floppy disk controller, IDE adapter interface, and I/O board takes another, leaving four free.

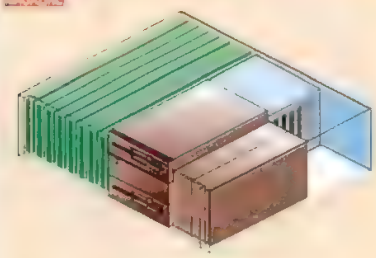
A sizable quantity of documentation accompanied the machine, but among the manuals for the Chicony combination floppy disk controller, Trident VGA card, BIOS reference manual, and 486/25 ISA motherboard, there was no user-oriented documentation to be found. Technically oriented users will certainly delight in reading this material, but if you have trouble distinguishing between DOS and a disk drive you'll find no solace in the printed matter.

Aside from otherwise standard service offerings, you will find a small gem in PC Brand's policies. Both parts and labor are fully covered by a one-year warranty, and during the first 90 days that warranty is handled on-site through TRW. After that the equipment is still covered through phone service or by returning it to PC Brand. But things get more interesting after that first year.

Under PC Brand's standard plan, parts coverage continues for four more years, but with restrictions: you have 80 percent coverage during the second year, 60 percent during the third, 40 percent during the fourth, and 20 percent during the fifth year. After that, you may want to sell your system and upgrade to whatever new technology is available. PC Brand offers a standard trade-in policy.

But you can do even better if you plan ahead for what you want. Should you decide to take PC Brand's five-year extended warranty (it costs 35 percent of the total system price and is available when

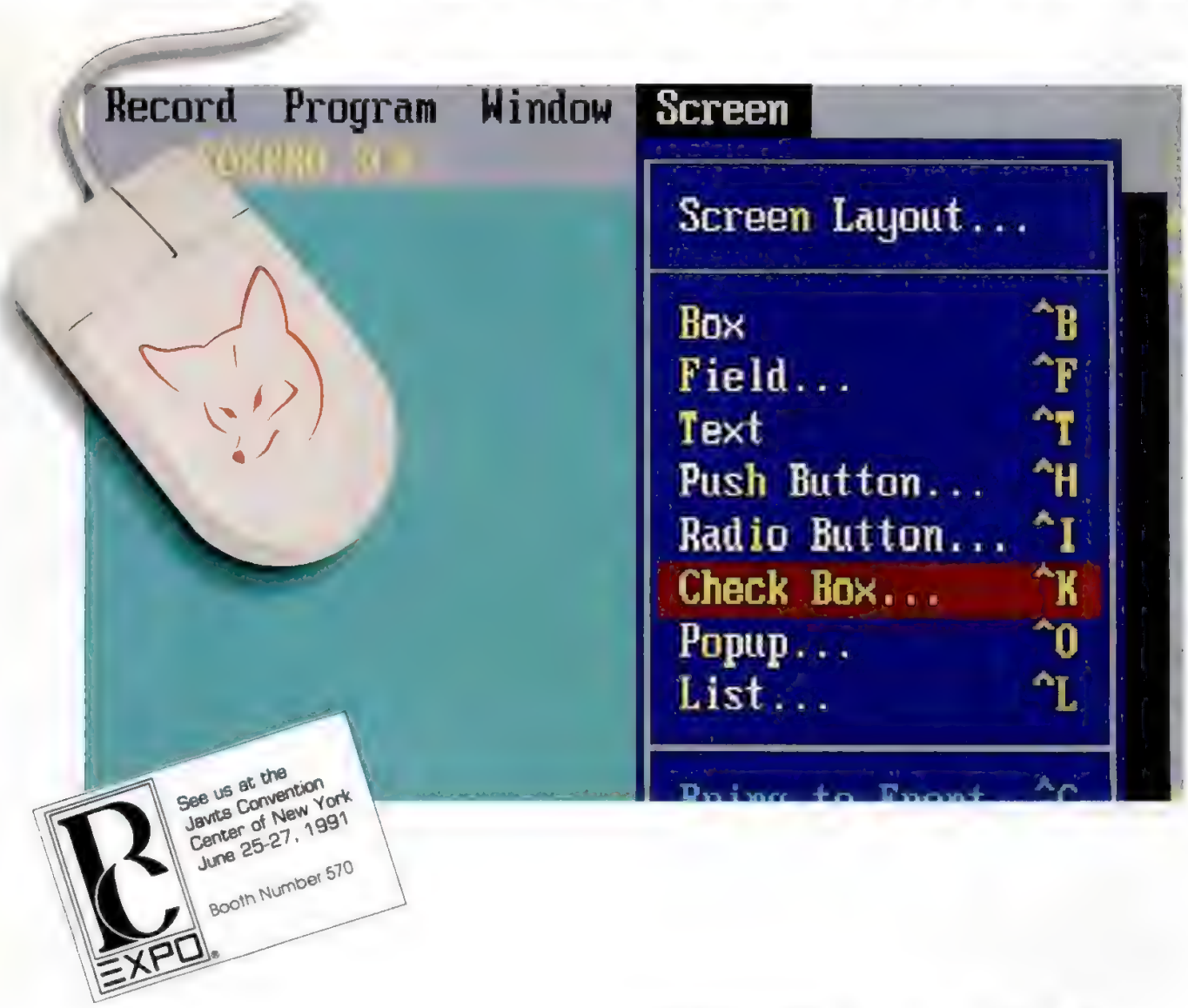
FACT FILE



PC Brand 486/25 ISA
PC Brand Inc., 877 Supreme Dr., Bensenville, IL 60106, 800-722-7263.
List price (tested configuration): $4,692.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 17-ms. 189MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Trident 1,024 by 768 adapter with 1MB RAM, CTX 13-inch monitor.
Software: DOS 4.01.

CIRCLE 416 ON READER SERVICE CARD

Introducing the DBMS runs like a mainframe.



Admit it .

Don't you get just a twinge of envy when you see a Mac user having fun while getting the job done?

You're not alone.

Millions of users who needed the power of the PC but wanted the ease-of-use of a Graphic User Interface (GUI) just splurged on Windows and the expensive hardware needed to get the most out of it.

But you don't have to do that.

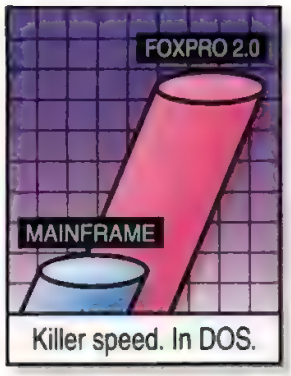
Because now there's FoxPro®2.0.

Why should the rich have all the fun.

FoxPro 2.0 gives you the ease-of-use of a Graphic User Interface on your character-based DOS PC.

Use pull-down menus to open multiple windows (in DOS) and see all the data you need to see at once. Build easy-to-use screens for entering and viewing data just by picking-and-clicking to place menus, buttons, checkboxes and scrolling lists anywhere you want them. Create sophisticated, elegant reports without the usual pain. Then assemble

that acts like a Mac and In DOS.



Killer speed. In DOS.

everything into your own custom applications.

Without writing a single line of programming code.

But that's only the tip of the iceberg.

Beneath its Mac-like interface, FoxPro delivers all the power and technology needed for your database management systems in the 1990s.

Our new memory management techniques let you work with the memory you have now while speeding up your applications.

Our new compound indexes are less than a quarter the size of those in competitive products and far, far faster.

Our new Relational Query-By-Example (RQBE) is a simpler, interactive interface to the information you need.

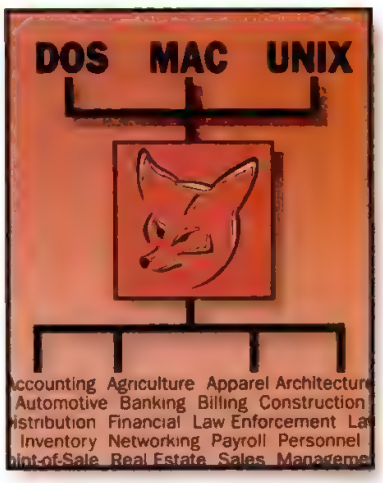
Our new Rushmore™ query optimization† accesses that information two orders of magnitude or more faster‡ than ever before.

You'll like being able to seamlessly use the SQL SELECTs that RQBE creates in any of your applications. (And the new UPDATE, INSERT and CREATE TABLE commands, too.)

And you'll love the fact that to the rich development environment we've always had, we've added a project manager that keeps track of all the needed files and any changes, then automatically builds your application or .EXE files. An API that lets you dynamically link to libraries you write in C or assembler with a single FoxPro command. A BROWSE FOR that's the basis for an entire application itself. Fourth Generation Language (4GL) tools that make adding event-driven code to fully relational screens, menus, reports and labels a snap.

And we've made our networking even better than when NSTL said:* "... multiuser databases fall into two general performance categories: FoxPro/LAN and all the others ..."

There isn't a DBMS in existence with the power of FoxPro.



The bigger your business, the bigger your investment.

So we've maintained downward compatibility with your existing systems, and you can use FoxPro 2.0 to run your current dBASE (and Fox) applications on your present character-based DOS PCs.

While you develop better, faster database management systems using all the advanced power of FoxPro 2.0 to satisfy your future information processing needs.

To get the most out of your investments, call and ask about our Upgrade-Any-DBMS-for-$195 offer.

Call now for your FREE demo disk.

FoxPro 2.0 runs on a 512K XT yet in extended mode uses every bit of power in a 386 or 486. To try it yourself, call Fox Software for a free copy of our fully-featured demo or the name of your nearest dealer.

You'll be amazed at what FoxPro 2.0 can do for you. In DOS.

Call 1-800-837-FOX2 today.

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In Canada call: (419) 874-0162

FoxPro 2.0

The complete power trip.™

† Patent applied for. ‡ A PC and FoxPro beat a mainframe and DB2 with a million-record, 200 megabyte database! * Quote from Software Digest Ratings Report, Vol. 7, Issue 13 (Oct. 1990) refers to FoxPro 1.02. Software Digest is a registered trademark of NSTL, Inc. Upgrade price valid only in U.S.A. and Canada. FoxPro TM Fox Holdings Inc. © Fox Holdings Inc. 1991.

CIRCLE 112 ON READER SERVICE CARD

you initially purchase the computer), you'll not only receive on-site coverage for both parts and labor during the extended warranty period, but you'll also get a discount on the standard motherboard trade-in prices. And you can take the full 30 days of the money-back guarantee period to decide.

With performance evening out among the various high-end computers, it's the extras that most often count. The 486/25 ISA may not be a more spectacular performer than most of the other computers in its class, but PC Brand's service policy does outclass the competition.

PEREGRINE COMPUTERS

Peregrine 425T

by Patrick Honan

Peregrine has been manufacturing personal computers for slightly less than three years, but its 425T reflects old-fashioned value.

Just $4,230 buys you a system in our standard configuration (with a 200MB hard disk): It's affordable and feature-rich, since Peregrine includes two floppy disk drives, *Windows* 3.0, and a Microsoft mouse with every system. The company charges $5,199 for the configuration we tested, which came with a 330MB ESDI hard disk and a 1,024-by-768 video subsystem.

Aside from these nondiscounted mail-order prices, Peregrine also sells through a small number of retailers and is slowly expanding its retail penetration, but retailers' prices are approximately the same as mail-order prices.

The 425T measures 24 by 7.5 by 16.5 inches (HWD) and has the keyboard lock and power, reset, and turbo switches on the front panel. It has more drive bays than do many tower machines: six half-height and two 3.5-inch bays. Five of the 5.25-inch bays and one 3.5-inch bay are accessible from the front.

There are six 16-bit and two 8-bit slots. The video board and floppy/hard disk controller each took up a 16-bit slot, and the I/O board occupied an 8-bit slot in the tested unit, leaving one 8-bit and four 16-bit slots open.

All memory is directly on the motherboard in SIMMs and therefore doesn't affect the number of free slots. The tested unit was expandable to 16MB of very fast 60-nanosecond RAM. Peregrine has since introduced a new motherboard design that accepts up to 40MB of RAM using 4MB SIMMs in one bank of eight SIMM sockets and 1MB SIMMs in a second bank of eight sockets.

The 128K RAM cache in the tested unit consisted of 35-ns. SRAM in a four-way set-associative caching architecture, but Peregrine tells us it recently switched to faster 20-ns. static-RAM for the cache. Optional cache sizes of 64K, 256K, 512K, 1MB, and 2MB are available. Such large capacities don't come cheaply—2MB costs $1,899, more than one-third the price of the tested configuration—and a 128K cache is probably sufficient for the applications most users will run. However, the larger caches might make a performance difference if you load the 425T with memory and use it as a server running memory-hungry applications, but results will vary from network to network.

STRONG TEST SCORES

The tested configuration more than held its own in the benchmark tests. The Diamond Computer 1,024-by-768 video board had the fastest time in the Direct to Screen access test, and the 60-ns. SIMMs helped the 425T tie with more than a dozen systems for the third-fastest time in the Conventional Memory test. The 80486 Instruction Mix and DOS File Access times were above average. The UltraStor hard disk controller came with no cache memory on it, but it can be configured with 1MB to 4MB of cached memory.

Peregrine includes free on-site service from TRW for the first year. At the customer's option, Peregrine will ship replacement parts overnight without waiting to receive the failed part if a component fails. Peregrine pays shipping for the new and failed parts. A toll-free technical support line has generous hours of 9 to 8 E.S.T., and 10 to 4 on Saturday. The war-

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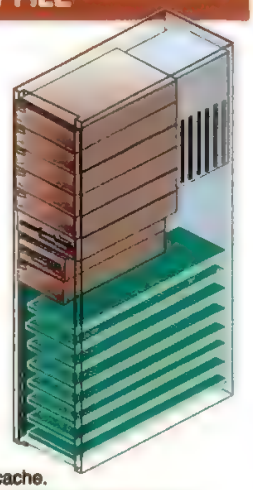
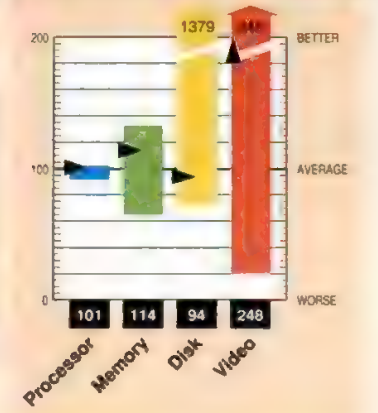


Peregrine 425T
Peregrine Computers, 110 E. Canal St., Troy, OH 45373; 800-326-7015; 800-544-6014 in Canada.
List price (tested configuration): $5,199.
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 128K cache.
Disk drives and controller: Micropolis 14-ms. 330MB ESDI, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 1,024 by 768 adapter with 1MB RAM, Optiquest 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

CIRCLE 417 ON READER SERVICE CARD

PEREGRINE 425T

TEST RESULTS



In short: The Peregrine 425T is a speedy performer with excellent video and memory scores. Very fast 60-nanosecond RAM contributed to its good memory timing. The disk test result was slightly above average if you take into account its uncached 14-millisecond ESDI hard disk. With RAM cache options that go as high as 2MB, and disk cache options of 1MB to 4MB on the hard disk controller (we test uncached ISA disk controllers only), this model is well equipped to handle highly complex applications.

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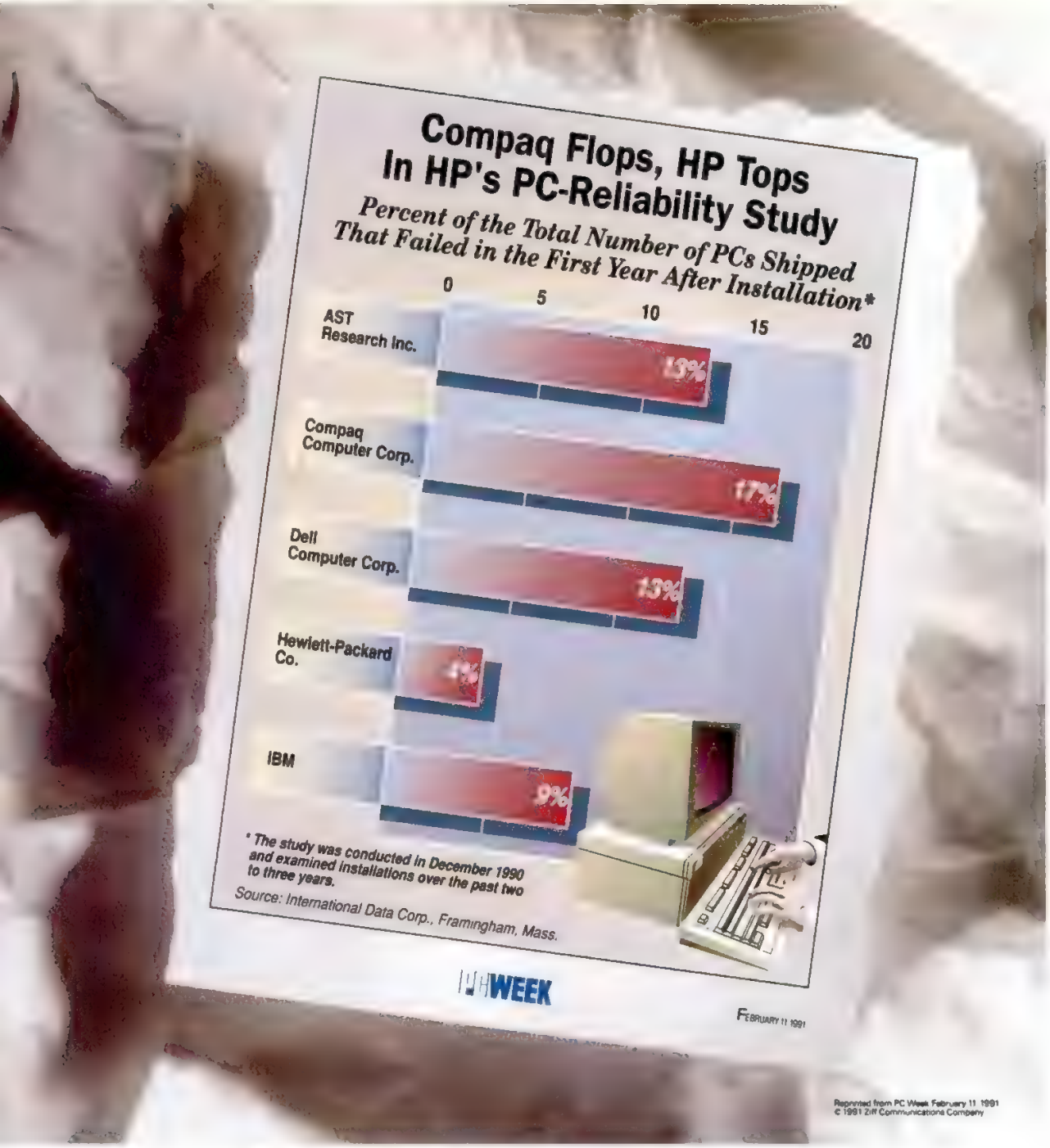

Reprinted from PC Week February 11, 1991
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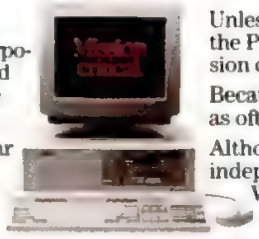
Most PC makers prefer not to discuss their failures.

You can see why.

International Data Corporation recently studied PC failures during the first year of use.

You're not likely to hear about the results the next time you buy personal computers.



Unless you buy HP personal computers, the PCs you can count on for your mission critical tasks.

Because Compaq's failed four times as often as ours. IBM's twice as often.

Although the report was completely independent, we commissioned it. With our reputation for reliability, we figured nobody else would.

For a copy of the IDC study, call **1-800-637-7740, Ext. 2299.** In Canada, call 1-800-387-3867. Then call your HP dealer for further discussions.

HEWLETT PACKARD

CIRCLE 262 ON READER SERVICE CARD

ranty covers parts and labor for one year.

Although the 425T's price is good, for only $300 more Peregrine's 33-MHz 486 is an even better value. If you're on a tight budget and can sacrifice some speed, consider Peregrine's 33-MHz 386 tower model for $4,499. In each case, a desktop version sells for $100 less than the tower. The main trade-off is that the desktop case has five drive bays compared with eight in the tower case.

As a relatively small and new manufacturer, Peregrine is struggling to make a name for itself. Given the strong blend of price and performance in the 425T, the company is well on its way to doing that.

POLYWELL COMPUTERS INC.

Poly 12/486-25A
Poly 486-25EISA

by Edward Perratore

Polywell Computers' Poly 12/486-25A and Poly 486-25EISA models share the distinction of superior video performance, exceptional upgradeability, affordable prices, and attractive service policies. But with vast differences in design quality, only the Poly 486-25EISA merits some consideration in this competitive market.

The Poly 486-25EISA we tested departed from *PC Magazine*'s standard configuration with its 340MB ESDI hard disk from Hewlett-Packard. Otherwise, this $6,200 setup included 8MB RAM, a 256K processor RAM cache, 1.2MB and 1.44MB floppy disk drives, and a Super VGA subsystem. A system matching our standard configuration, with a 200MB ESDI and one high-density floppy disk drive, would cost $575 less, or $5,625.

Polywell's ISA model, the Poly 12/486-25A, came with 8MB RAM, a 512K processor RAM cache, a 200MB ESDI hard disk from Maxtor Corp., two floppy disk drives, and a Super VGA subsystem. This 12-slot model costs $5,300 ($75 less with only one floppy disk drive).

POLY 486-25EISA

Intended primarily as a file server or CAD/CAM workstation, the desktop Poly 486-25EISA fits up to 64MB RAM onto its Advanced Integration Research motherboard. Present are name-brand parts: an Intel chip set and processor cache controller; a Phoenix BIOS. If you desire, you also can install a Weitek 4176 coprocessor directly on the motherboard.

The motherboard of our test model accepts 8MB of 1MB 70-nanosecond SIMMs and the maximum 256K of processor RAM you can install using 256-kilobit 35-ns. SRAMs. All eight expansion slots accept standard 32-bit EISA cards, but there's one hitch: The housing for the left-most drive bays blocks the right-most slot so that nothing longer than a one-third-length board will fit.

Among other distinguishing features of this EISA model's design, the vendor has included space for a second fan aimed at your expansion boards. Unfortunately, Polywell does not sell this second fan; if you want it, you'll have to buy it from a reseller or some other vendor.

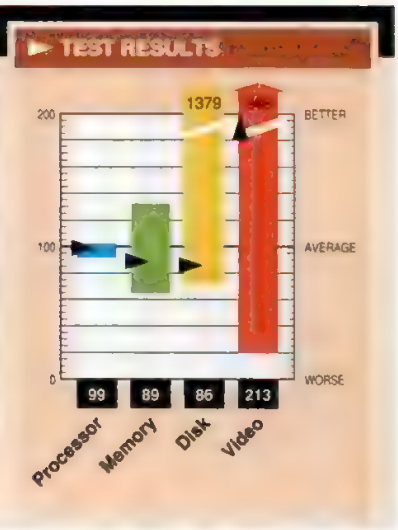
In testing, the Poly 486-25EISA performed with the middle of the pack across the board with one exception. Its 1MB-laden SpeedSTAR VGA card, from Diamond Computer Systems, performed above average on tests. The ViewSonic 4 monitor from Matsushita included with our test model also displays at the same 1,024 by 768 resolution.

POLY 12/486-25A

The company's ISA-bus Poly 12/486-25A performed similarly in testing to its EISA sibling. Even the video scores were comparable, despite the fact the ISA system we tested had an OmniTel adapter installed. (Polywell says it recently began including the Diamond card in both the ISA and EISA models.)

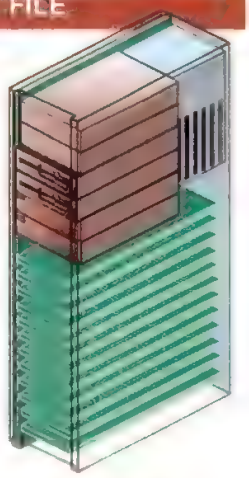
This tower model, intended primarily for the engineering market, is priced lower than the EISA machine yet offers a few components that outclass those of the EISA. Our test model's processor RAM cache, for instance, included a maximum 512K, and in 25-ns. rather than 35-ns.

POLY 12/486-25A



In Short: The ISA-bus Poly 12/486-25A turned in better processor and memory scores than its EISA counterpart, but the 14-millisecond ESDI disk turned in a slightly below-average score compared with other ISA systems. The video timing was excellent, thanks to the Diamond SpeedSTAR video adapter. Unfortunately, this system showed a number of design defects, such as the motherboard's poor fit in its case. And the SIMM banks interfere with as many as five of the motherboard's 12 slots.

FACT FILE



Poly 12/486-25A
Polywell Computers Inc., 61-C Airport Blvd., South San Francisco, CA 94080; 800-999-1278, 415-583-7222.
List price (tested configuration): $5,300.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 512K cache.
Disk drives and controller: Maxtor 14-ms. 200MB ESDI, Data Technology controller, 1.2MB and 1.44MB floppy disk drives.
Display: Omnitel 1,024 by 768 adapter with 1MB RAM, Matsushita 14-inch monitor.
Software: DOS 4.01.

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***InfoWorld*, "We find the ZEOS '386 an excellent value. Speed: Excellent. Compatibility: Excellent. Value: Excellent."**

***Government Computer News*, "Arguably the fastest MS-DOS and OS/2 micro in the world."**

***PC Resource*, "ZEOS ...provides quality comparable with IBM or Compaq and does so for about 70% of the price."**

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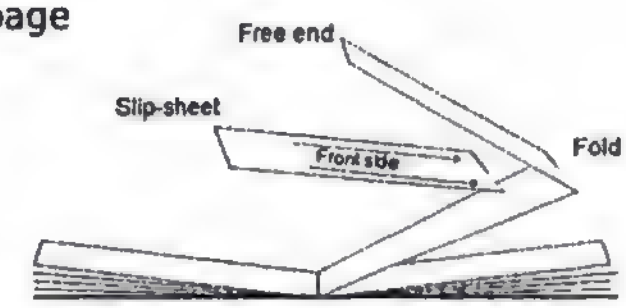
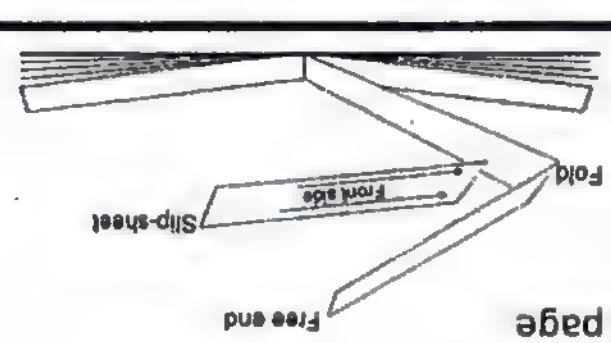
4. Close the page and slip-sheet





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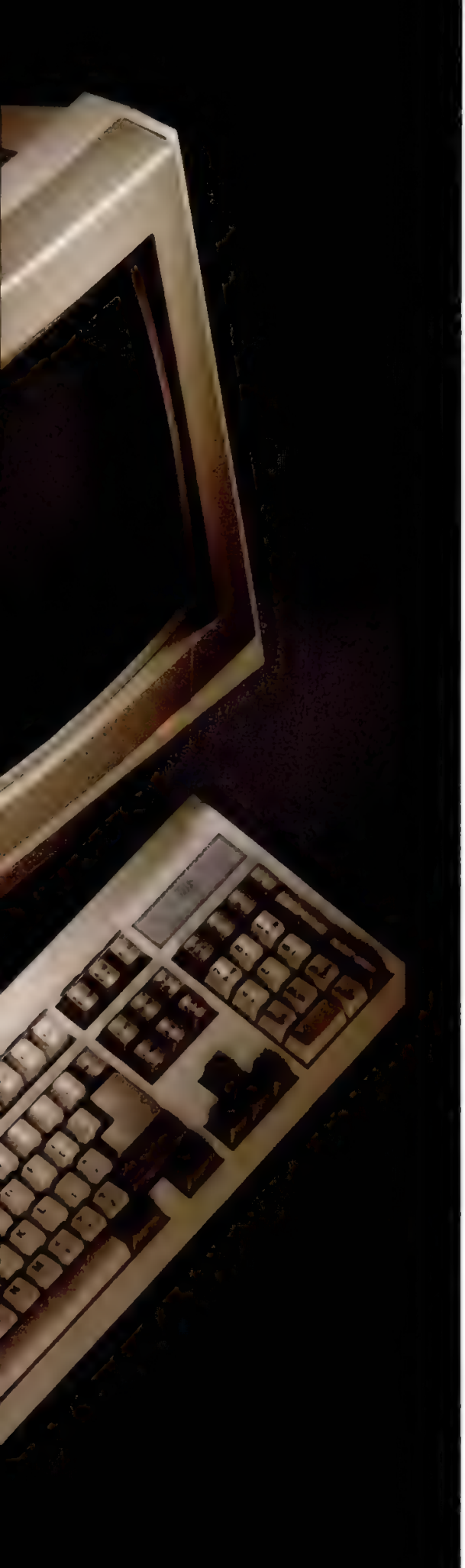

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In one recent '386 review, *PC Magazine* awarded ZEOS Editor's Choice. "The ZEOS '386 blows away every other computer... a smart choice" is what they said. And in another recent review, *Government Computer News* said the ZEOS 33MHz '386 is "arguably the fastest MS-DOS and OS/2 micro in the world."

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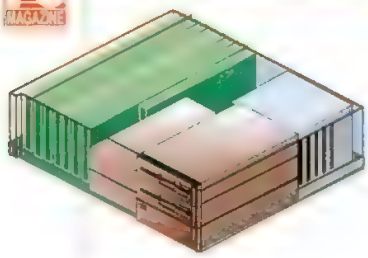


Poly 486-25EISA
Polywell Computers Inc., 61-C Airport Blvd., South San Francisco, CA 94080; 800-999-1278, 415-583-7222.
List price (tested configuration): $6,200.
Memory and processor RAM cache: 8MB 70-ns. SIMMs. 256K cache.
Disk drives and controller: Hewlett-Packard 17-ms. 340MB ESDI; Data Technology controller. 512K cache; 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 1,024 by 768 adapter with 1MB RAM. Matsushita 14-inch monitor.
Software: DOS 4.01.

CIRCLE 419 ON READER SERVICE CARD

SRAMs. The ISA's case houses one accessible 3.5-inch drive bay besides its six half-height bays, five of which are accessible; the EISA model allows for six half-height devices. The Poly 12/486-25A comes with a whopping 12 expansion slots to the EISA model's eight, and its power supply is 250 watts, 30 higher than the EISA's.

Look closer, however, and you'll see very good reasons for the price difference. First, the 8MB RAM on Polywell's motherboard is made up of 80-ns. chips—slow for a 486/25, though this PC is not the only one reviewed to use these relatively slow chips. OPTi makes the chip set (not Intel), and—probably most significantly—the disk controller is noncaching.

LESS THAN PERFECT

Other reasons for the price difference are more disturbing. In our test model, the motherboard was positioned too low in the case for the video, disk controller, and I/O cards to fit snugly without bending their upper brackets. Furthermore, our efforts to secure the video card in the leftmost slot released the grip of a plastic standoff in the left rear corner. This resulted in some up-and-down movement in the motherboard's corner whenever we attempted to install or remove anything. To the vendor's credit, Polywell intends to modify the mounting bracket on the SpeedSTAR video card, which had the most trouble fitting.

The unit's other design problem is its positioning of the four RAM banks directly in the path of boards installed in up to five of the 12 slots. Here, of course, the use of 4MB SIMMs comes in handy. And even if you use as many as six full-length boards (the seventh is an I/O card), you'll never have to worry about their slots.

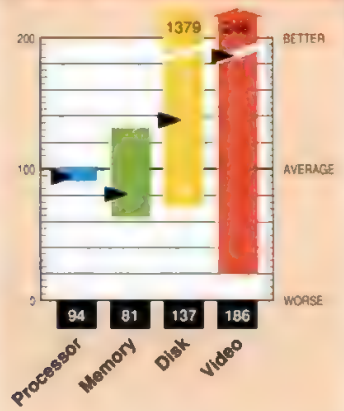
But if you're running slot-happy applications that require you to fill up the machine with both RAM and expansion cards, keep in mind that filling up all four banks to their maximum will reduce three slots to a maximum capacity of two-thirds-length cards and two others to a one-third-length maximum. Even filling only one bank with 4MB SIMMs (for an 8MB total) requires you to give up two full-length slots (though you'll still be able to use two-thirds-length cards).

If you opt for either machine, you'll find Polywell's service policies refreshing. Both machines come with a five-year labor warranty, the first year of which is on-site. And while the general parts warranty is for one year, the SpeedSTAR card's runs for two years, the Chicony keyboard's runs for three years, and the Maxtor hard disk's is for two years (the EISA model's HP hard disk carries a five-year warranty). The ISA model's Polywell motherboard, for all its troubles, also carries a two-year warranty.

Tack on the company's ten-year, toll-free phone support policy and its 30-day money-back guarantee, and you have bargain prices that, at least for the EISA model, make for an attractive possibility.

POLY 486-25EISA

TEST RESULTS



In Short: Polywell Computers' low-priced EISA entry lagged in both processor and memory scores, though its disk test score compared favorably with those of other systems with caching controllers. The OmniTel video subsystem showed good speed, too. Beyond performance, the system shows signs of intelligent design that are lacking in the company's ISA machine.

REASON TECHNOLOGY INC.

Square 4

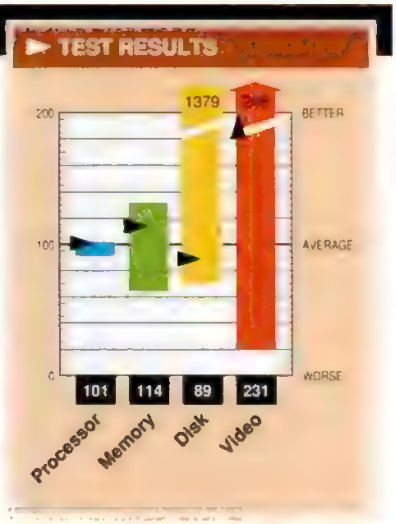
by Bill O'Brien

You can't tell a computer by its enclosure. Reason Technology has employed a minimalist design and slipped its Square 4—a 25-MHz 486 ISA machine—into a bona fide small-footprint case. The company has also given the Square 4 a small-footprint price.

Although there is ample expansion room, Reason packs its technology into a 6- by 16- by 15.3-inch box with great skill. And charging $3,915 for a system that matches *PC Magazine*'s standard configuration (8MB of RAM, a 200MB IDE hard disk, one 1.2MB or 1.44MB floppy disk drive, and a 512K Diamond SpeedSTAR video card) is an equally admirable feat. If you need two floppy disk drives, add $80 to the price; this is the configuration we tested.

Processor RAM cache is missing from the list; this system relies solely on the internal 8K in the 80486 processor. Adding 128K of SRAM for cache is a $300 option, but even without it, the Square 4 came through PC Magazine Labs' Instruction Mix and Conventional Memory

SQUARE 4



In Short: The only drawback of the ISA-based Square 4 is its IDE hard disk, which does not share in the potential of the environment created by the 486's enhanced technology. Nonetheless, using an IDE drive and leaving out processor RAM cache (which evidently did not hurt the test score) lets Reason Technology offer the system at a lower-than-average price.

tests competitively. Reason Technology's 33-MHz 80386, in the same configuration, comes with 256K of cache—for $500 less than the Square 4.

SMALL BUT EXPANDABLE

Although theoretically a little tight for expansion room, the Square 4's small enclosure manages to hold three accessible half-height bays and two vertical 3.5-inch bays behind the front panel. That's just enough half-height space to hold the two floppy disk drives and still leave one bay open. But Maxtor's 3.5-inch hard disk takes up both of the smaller bays. The Seasonic 200-watt power supply will keep things humming even if you fill all five bays.

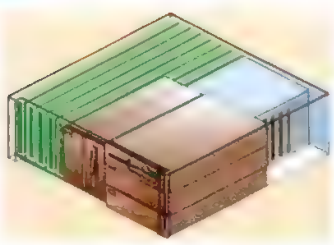
Reason Technology manufactures the motherboard, using an OPTi chip set. With cache controlling duties included among the chip set functions, the company can offer the cache as an option. The board contains 8 SIMM slots for 8MB of system memory, as well as a proprietary 32-bit expansion slot that can accomodate an additional 8MB of carded SIMM RAM. The seven remaining slots are all 16-bit; with the Diamond video card using one and a combination floppy disk controller, IDE adapter interface, and I/O board using only one other slot, five remain for future additions.

As you might expect, the Diamond card performed quite well on our video benchmark test. As for disk performance, IDE may not be the best interface for an 80486 running an 8-MHz ISA bus; the Maxtor hard disk fell behind the group average on the DOS File Access test. Reason Technology offers an optional 12-MHz bus speed, which may well spark the IDE drive to life. Otherwise, a 300MB ESDI drive should be more effective, although it boosts the system's price by $800.

Reason Technology's service and support policies are anything but minimal. Parts and labor are covered for two years, and although coverage is currently handled via toll-free phone support and parts shipping, the company says it is investigating on-site service options and may have a revised plan in the near future.

Make no mistake: This is a minimalist system among 486-powered computers. Adding the optional processor RAM cache and switching to a more competent ESDI hard disk pumps up the price to almost $5,100. At that price, the Square 4 is no longer a bargain, but a highly competitive 486 at a still competitive price. In either configuration, it remains a desirable working partner.

FACT FILE



Square 4
Reason Technology Inc., 290 Coon Rapids Blvd., Minneapolis, MN 55433; 800-800-4860.
List price (tested configuration): $3,995.
Memory and processor RAM cache: 8MB 80-ns. SIMMs.
Disk drives and controller: Maxtor 15-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 512K 1,024 by 768 adapter, Mag Computronics 14-inch monitor.
Software: DOS 4.01.

CIRCLE 420 ON READER SERVICE CARD

SAI SYSTEMS LABORATORIES INC.

SAI 486/25 ISA

by Bill O'Brien

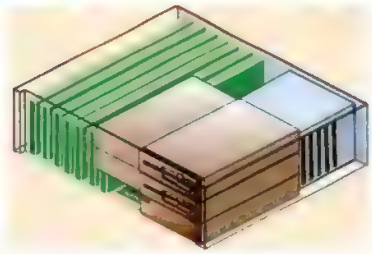
SAI has put together a mixture of top-drawer components under a tried-and-true formula that mixes old and new technologies to wean you away from IBM. The SAI 486/25 ISA is a tempting morsel for potential 80486 owners, although it may not be the best bargain SAI offers.

Even though it is not the least expensive computer in the group, the SAI model is one of the lower-cost entries: $3,825 for *PC Magazine*'s standard configuration, with 8MB RAM, 256K processor RAM cache, a 200MB hard disk, one high-density floppy disk drive, and a Super VGA subsystem. In the tested configuration, with two floppy disk drives, the system costs a mere $70 more.

STANDARD AT WORKS

SAI has wrapped the components in a desktop-style case with a modernistic front panel containing the usual assortment of status LEDs and turbo and reset buttons. Under this facade, the chassis is basic AT design. Three half-height bays poke through the front panel and are occupied by the 1.2MB and 1.44MB floppy disk drives. Two adjacent half-height bays sit behind the front panel, and SAI has chosen this location for the Conner IDE hard disk. This disk is the only major throwback in the system, posting a below-average benchmark test score. A Quantra 200-watt power supply proved ample for the

FACT FILE



SAI 486/25 ISA
SAI Systems Laboratories Inc., 911 Bridgeport Ave., Shelton, CT 06484; 203-929-0790.
List price (tested configuration): $3,895.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 256K cache.
Disk drives and controller: Conner 15-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 1,024 by 768 adapter with 1MB RAM, ADI 14-inch monitor.
Software: DOS 4.01.

CIRCLE 421 ON READER SERVICE CARD

installed devices and should be powerful enough for any devices you install in the two remaining drive bays.

SAI Systems Laboratories has commissioned an AIR (Advanced Integration Research) motherboard using an AMI BIOS and Intel chip set. The AIR board provides you with 16 SIMM slots; the computer's 70-nanosecond RAM can be expanded to 16MB with 1MB SIMMs or to 64MB with 4MB modules. The motherboard's performance was below average on our memory and processor tests.

Of the eight 16-bit ISA bus connectors, three are occupied by the I/O board, floppy disk controller, and video board, leaving you five full-length slots available for future expansion.

We've come to expect racy performance from Diamond's SpeedSTAR VGA card, and it proved to be no letdown. Thanks in part to the Tseng Laboratories BIOS and in part to the BIOS shadowing that SAI employs, the card turned in a respectable time on our video test. Coupled with the ADI Super VGA monitor, its color output is accurate and its images stable, even at the maximum resolution of 1,024 by 768 pixels.

STRONG DOCUMENTATION

SAI was once known for its less-than-helpful documentation, but this is no longer the case. Prominent among the documentation are the almost mandatory technical specifications for the motherboard. But far thicker is the user manual in its three-ring binder. It's well written and inlaid with true user information explaining the whys and wherefores of system setup, as well as how to avoid possible pitfalls.

SAI has a 30-day money-back return period in which you can make certain that its computer will run your applications the way you intended. During and after that period, technical questions are handled by SAI's support team, available Monday through Friday between 10:00 and 5:00 E.S.T. The support number is not toll-free, and its times of operation may be inconvenient to customers on the west coast. However, SAI's support team knows the equipment and will give you quick answers to most questions.

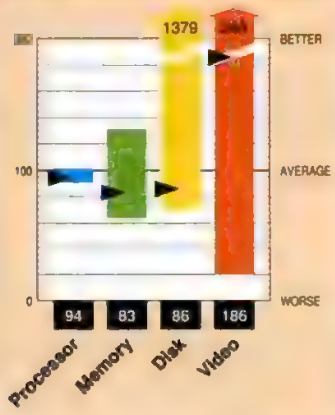
Although SAI offers only one-year protection on parts, the labor warranty is good for three years (and labor can constitute most of the expense in any repair). This coverage extends to phone diagnostics and parts shipping, or you may return the system to SAI for repairs. The company does offer an optional on-site service policy, for $99.

A similarly equipped SAI 386/33 (with a 128K cache) costs $800 less than the 486/25 ISA—although because of its slow IDE hard disk, you may not notice much diference between these two machines. (SAI lists an identically priced 180MB ESDI disk offering greater speed but reduced capacity.) If you must have an 80486, SAI's 33-MHz model is $650 more in the same configuration.

For predominantly processor- and RAM-based applications, the SAI 486/25 ISA is a good deal. Even if you're on a budget, however, SAI's 486/33 version will keep you close to the cutting-edge technology longer, and it is the best value in the SAI line.

SAI 486/25 ISA

TEST RESULTS



In Short: While nothing is wrong with the SAI 486/25 ISA's somewhat slower-than-average processor, memory, and hard disk timings, few attributes make it stand out. The service policy is hampered by the lack of an on-site option and by the 10:00-to-5:00 phone availability (E.S.T). The 33-MHz 80386 model offers a significant savings without imposing a major detriment in performance. And while video speed and fine documentation are obvious benefits, they may not be enough to offset the weaknesses.

SOFTWORKS DEVELOPMENT CORP.

Citus 486 TS 25i

by Henry Fersko-Weiss

The most notable characteristic of Softworks Development Corp.'s Citus 486 TS 25i is its potential. By adding a bracket, you can get up to nine half-height drive bays in its standard tower case. This computer also has one of the neatest interiors around; all the wires are tied up and well routed. There are few other distinguishing features, and the Citus's performance is average.

PC Magazine's standard configuration costs $4,595, with 8MB of RAM, a 128K processor RAM cache, a 213MB hard disk, a 1.2MB or 1.44MB floppy disk drive, and a Super VGA subsystem. The unit we tested came with a 668MB SCSI hard disk and an additional floppy disk drive, for a total cost of $6,005. These prices are a bit high for systems from a less-known vendor, even with the mon-

Our 8ppm printer earned the Okidata OK!™ by offering you something the LaserJet® III doesn't.

The OL800: 8ppm page printer $1499

The OL820: W/built-in font scaling $1999

The OL840: W/PostScript $2999

The OL800: W/200 sheet 2nd paper tray

The OL820: W/200 sheet 2nd paper tray

The OL840: W/200 sheet 2nd paper tray

The OL800: W/multi-user port (3 add'l users)*

The OL820: W/multi-user port (3 add'l users)*

The OL840: AppleTalk Network Ready

Freedom of choice.

Your best choice in an 8 ppm page printer is the one that gives you the most to choose from: the Okidata OL800 Series.

With Okidata, you're free to choose the features you need, free to save money by eliminating features you *don't* need, and even free to change your mind later.

The OL800: No Frills, But All The Options.

For only $1499** list, the Okidata OL800 gives you a full-featured 8 ppm printer: 26 fonts, 4 typefaces, HP Series® II compatibility, both serial and parallel interfaces, and the industry's only 5-year warranty—on Okidata's unique LED printhead.

As your needs grow, you can easily add options that are *no* option with the LaserJet® III—a second paper tray for more flexible paper handling, or a network port that automatically accepts output from three additional PCs in a workgroup. You can even upgrade your OL800 to match either of our high-performance printers described below.

The OL820: Faster Than A LaserJet III.

Besides having more resident scalable fonts than the LaserJet III (13 versus 8), the OL820 also has more brains. Thanks to a unique hardware chip designed by Okidata engineers, it instantly solves complex font scaling, type rotation and grayscaling problems "on the fly"—problems the LaserJet has to go back to its software to work out.

So the Okidata OL820 can deliver up to three pages of sophisticated text while the LaserJet III is still thinking about printing its first page. In fact, InfoWorld magazine found the Okidata OL820 to be "the fastest office printer we've tested."

Second paper tray and 4-station workgroup options are available for your Okidata OL820 as well.

The OL840: PostScript From PC To Mac And Back.

If Adobe PostScript® printing is on your menu, the Okidata OL840 offers it for $700 less than a comparably equipped HP. Yet that low list price includes 35 genuine Adobe PostScript fonts, plus 26 bitmapped fonts (4 typefaces); 2 megabytes of installed RAM; plus serial, parallel, and AppleTalk Network® interfaces. You can connect the OL840 to both PC and Macintosh® workstations, and switch between systems instantly.

And the OL840 still leaves you with plenty of options—a second paper tray, extra memory, and a wide selection of additional PostScript fonts on easy-to-install ROM cards.

Finally, every Okidata OL800 Series printer has earned the Okidata OK!—your personal promise from us that it will deliver not just good value, but exceptional value...will provide not just adequate performance, but outstanding performance.

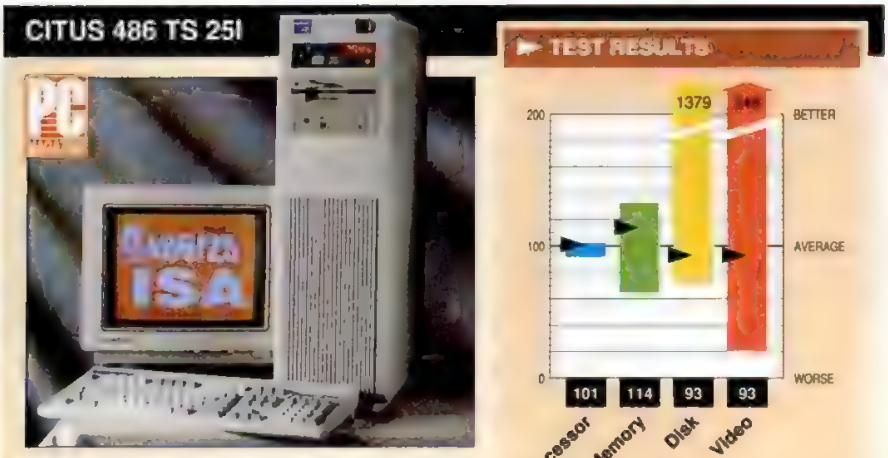
If you're looking for an 8 ppm page printer, your best choice is the one that gives you freedom of choice—the Okidata OL800 Series. For additional information please call 1 (800) OKI-DATA.

We don't just design it to work. We design it to work wonders.™

*Automatic selection of PC Interf. **Manufacturer's suggested retail price. Dealer price may vary. HP Series, LaserJet, Adobe PostScript, AppleTalk Network, Macintosh are trademarks of their respective corporations. Okidata is a registered trademark of Oki America Inc. Marque déposée de Oki America Inc. Oki OK! is a trademark of Oki Electric Industry LTD. "We don't just design it to work. We design it to work wonders." is a trademark of Oki America Inc. InfoWorld 10/1/90.

CIRCLE 235 ON READER SERVICE CARD

CITUS 486 TS 25I



In Short: The test scores for the Citus 486 TS 25i were generally within the norm. With its 70-nanosecond RAM and 25-ns. processor RAM cache, it turned in a top memory score and slightly above-average processor score. The system is reasonably expandable; it offers seven drive bays with the potential for nine, and it can accept up to 64MB of RAM on the motherboard.

strous hard disk, but Citus machines are mainly sold at a considerable discount to Novell and Unix dealers who add to the systems.

When you open the Citus box, no mass of wires will pop out at you because they are all clipped together and as far out of the way as possible. This is helpful because the machine is packed with drive bays. In addition to the three half-height bays accessible from the front, there are two bays turned sideways underneath them, and two others suspended from the top. The two mounted sideways are on cross braces, with screw holes for another drive bracket. This would let you add two more half-height drives, bringing the total up to nine.

BUILT FOR THE FUTURE

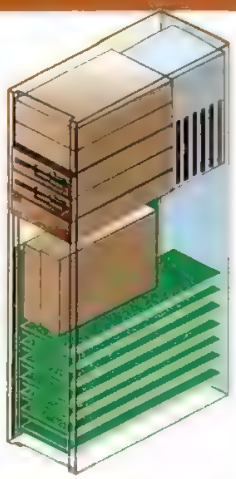
The motherboard in the computer is also built for expansion. The 16 SIMM slots can hold up to 64MB of RAM if you use 4MB SIMMs. The board comes from Softworks and uses the OPTi chip set. The unit we tested had chips rated at 70 nanoseconds. On our processor and memory tests, the machine performed slightly better than average. One reason for this is the 25-ns. SRAMs used in the 128K processor RAM cache.

On the disk and video tests, however, the Citus performed somewhat below average. The Micropolis hard disk is rated at 16 milliseconds, but the SCSI interface tends to be a bit slower than some of the other interface choices. The video card, which has a Softworks label, uses a Western Digital (formerly Paradise) chip set and has 512K of RAM on it.

The computer comes with a typical one-year warranty on parts and labor. Atypical is the free on-site service provided by Monroe Systems for Business, a New Jersey–based service company with 260 branches nationwide.

While the Citus 486 TS 25i has lots of room for drive bays and can get up to 64MB of RAM on the motherboard, its performance was no better than average. If performance is crucial, a sister machine—the Citus 486/33 computer—makes more sense. In our standard configuration, this 33-MHz machine costs only $500 more and, according to Softworks, yields 45 percent better processor performance. Our tests indicate that the 486/33 shaves about 25 percent off the 486/25 processor timing. But even that increase justifies going with the faster machine.

FACT FILE



Citus 486 TS 25I Softworks Development Corp., 10202 N. Enterprise Dr., Mequon, WI 53092; 800-332-3475, 414-242-8800.
List price (tested configuration): $6,005.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Micropolis 16-ms. 668MB SCSI, Western Digital controller, 1.2MB and 1.44MB floppy disk drives.
Display: Softworks 512K 1,024 by 768 adapter, Goldstar 14-inch monitor.
Software: DOS 4.01.

CIRCLE 422 ON READER SERVICE CARD

TANGENT COMPUTERS INC.

Tangent Model 425i
Tangent Model 425e

by John R. Quain

The last time we reviewed a Tangent 486 PC (the 33-MHz Tangent 433i, *PC Magazine*, February 12, 1991), we were not exactly thunderstruck by its features or performance. But this time around, Tangent has presented two superior 25-MHz 486-based systems, each with its own set of virtues.

Both the mini-tower ISA Model 425i

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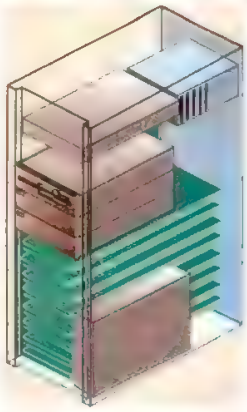
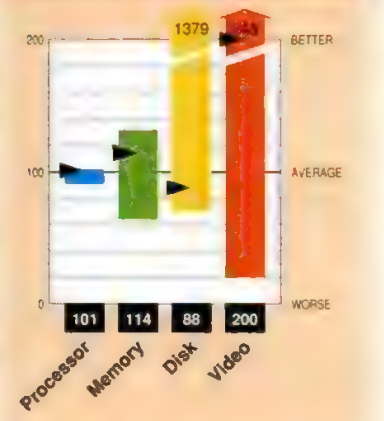


Tangent Model 425I Tangent Computers Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-223-6677, 415-342-9388.
List price (tested configuration): $4,084.
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 15-ms. 207MB IDE, 1.2MB floppy disk drive.
Display: Sigma Super VGA adapter with 1MB RAM, Mag Computronic 14-inch monitor.
Software: DOS 4.01.

CIRCLE 423 ON READER SERVICE CARD

TANGENT 425I



In Short: Like its EISA counterpart, the Tangent Model 425i offers significant benefits. The $4,084 ISA mini-tower unit stuffs a considerable amount of power and flexibility into a small package. The 15-millisecond Maxtor hard disk was slower than we had hoped, but the 70-nanosecond interleaved page-mode DRAM easily kept up with the ISA leaders on our memory test. The Sigma Designs Legend Plus video adapter, with 1MB of RAM, also turned in excellent performance.

and the full-tower EISA Model 425e come with a 1.2MB floppy disk drive, a Super VGA subsystem, and a responsive Key Tronic keyboard. After that, they diverge considerably.

MODEL 425i

Tangent packs a considerable amount of power and flexibility into the Model 425i's 15.3- by 8.5- by 16-inch case. In our standard configuration, this $4,084 ISA mini-tower system is not much bigger than the monitor it comes with, yet it uses a full-size Dash motherboard. You'll find an OPTi chip set and AMI BIOS with advanced CMOS setup on the motherboard. The advanced CMOS enables you to optimize the system for specific applications, such as LAN management, by changing the bus speed (from 6.25 MHz to 8.3 MHz or 12.5 MHz), the wait states (from 0 through 2), the cacheable address range, and the RAM block sizes.

The Dash motherboard will support a Weitek 4167 coprocessor and, in our tested configuration, it comes with 8MB of SIMM RAM (16MB maximum on-board) and a 25-nanosecond 128K external processor cache (an optional 512K is available). Space is very tight in the minitower case; the SIMMs vie for room with the slim 275-watt PC Power & Cooling power supply. Nonetheless, Tangent has kept the Model 425i expandable by fitting a tiny 207MB IDE Maxtor hard disk into a 3.5-inch bay and using an integrated disk controller and I/O board to save one expansion slot. That leaves the user six free expansion slots and three open half-height bays to play with.

Targeted at small business and home users (with FCC Class B certification pending), the Model 425i's performance proves that it has the potential to please either audience. The 15-millisecond hard disk was a bit slower than we hoped, but the 70-nanosecond interleaved page-mode DRAM easily kept up with the ISA leaders on our Conventional Memory test. The Sigma Designs Legend Plus video adapter with 1MB of RAM yielded excellent performance. Though the potential for managing a small LAN is certainly within the Model 425i's capabilities, it seems best suited for CAD designers and art directors who will appreciate Sigma's Targa file compatibility and the minitower case's small footprint.

MODEL 425e

On the other end of the spectrum, Tangent's Model 425e (with an FCC Class A rating) has been built for the LAN manager who has everything except a lot of money. Priced at $6,284 in our standard configuration, the Model 425e comes with a tower case, an Intel chip set on a Mylex motherboard, 8MB of 70-ns. interleaved SIMM RAM, a 207MB hard disk, and two BIOSes: a Phoenix BIOS for basic DOS work and a Mylex EISA BIOS for users who seek greater rewards. For example, users with Unix or a DOS extender such as Farlab will be pleased to discover that the Model 425e will manage up to 32MB of RAM on the motherboard (Tangent charges $89 per megabyte for 70-ns. RAM). The 25-ns. processor RAM cache is fixed at 128K, however.

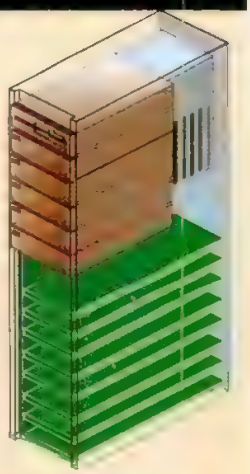
If you need a PC that can handle multiple hard disks, the Model 425e will accommodate you with a Mylex bus-mastering synchronous SCSI controller with 1MB of cache. The controller will handle a maximum of 16MB of cache and seven drives. The system has additional room for four accessible half-height drives and five expansion cards. The 270-watt PC Power & Cooling power supply, with eight device connectors, ought to handle anything you care to install.

COMPARISONS

One obvious comparison for the Model 425e is the Zeos 486-25C, another EISA machine we reviewed in this roundup. The Zeos machine uses the same Mylex motherboard and Mylex SCSI controller, although Tangent installs faster 60-ns. chips on the controller (Zeos uses 70-ns. chips). The main differences are that Zeos offers two more one-third-height drives, a larger power supply, and a Diamond SpeedSTAR video adapter—at an additional cost of almost $1,400.

FACT FILE

EDITORS' CHOICE



Tangent Model 425e
Tangent Computers Inc., 197 Airport Blvd., Burlingame, CA 94010; 800-223-6677, 415-342-9388.
List price (tested configuration): $6,284
Memory and processor RAM cache: 8MB 70-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 15-ms. 207MB SCSI; Mylex controller, 1MB cache; 1.2MB floppy disk drive.
Display: Sigma Super VGA adapter with 1MB RAM, Mag Computronic 14-inch monitor.
Software: DOS 4.01.

CIRCLE 424 ON READER SERVICE CARD

INTRODUCING

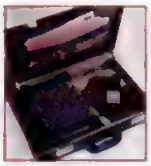
MOBY BRICK™

486 Power, 500 MB Hard Disk, 32 MB RAM. Now You Can Have It All—Wherever You Go!

Now there is no reason to compromise between power and portability. Moby Brick combines the best attributes of desktops and laptops.

As a desktop, Moby Brick offers blazingly fast performance and enormous storage capacity. It has the same award winning design and nearly silent operation as the original 386SX Brick.

Yet when you need your PC away from the office, Moby Brick's versatility offers an alternative to the limitations of laptops and the hassle of multiple machines. It's simple—at your frequent destinations, keep a full-size keyboard and color monitor and just carry the Brick in between. For travel, add the LCD display module to convert Moby Brick into a full featured AC portable.



Massive Power and Storage

Moby Brick is only about the size of a ream of copy paper and weighs 8.9 lbs., yet it packs full desktop power with either a 20 MHz 486SX or 33 MHz 486DX processor with up to 32 MB RAM. The new Intel 486SX is faster than a 33 MHz 386DX; the 486DX is twice as fast and includes a built-in numeric coprocessor. A modular processor board allows easy upgrades from the 486SX to the 486DX at any time.

Bricks use fast, reliable IDE Conner hard disks ranging from 44 MB up to 510 MB. The unique BIOS integrated disk cache (up to 8 MB) offers lightning quick access times. The bus is selectable between 8 MHz (AT standard) or 10 MHz which improves video, disk and network performance. Other standard features include a 2,400bps modem, 3.5" 1.44 MB floppy, 180 pin docking connector and an ISA 16-bit internal half length expansion slot. The "Stretch" Brick, which is 7" longer, accepts one full and one half length card. The rugged aluminum case with shock absorbing rubber corners is available in granite or beige along with color coordinated keyboards and monitors.

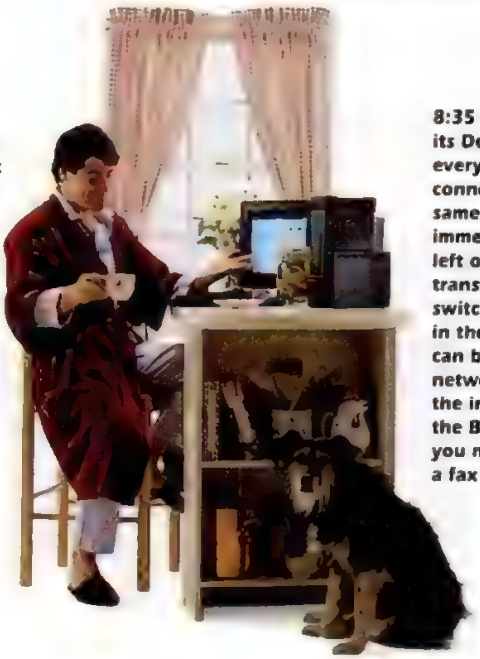
Extraordinary Graphics

Moby Brick features built-in 16-bit Super VGA graphics with 1 MB RAM. Maximum resolution is 1024 x 768 non-interlaced. The Edsun CEG (optional at no extra charge) provides antialiasing to double the apparent resolution and provides 32,000 simultaneously displayable colors for stunning photo-realistic graphics. Now you can say good-bye to the jaggies, even on low resolution 640 x 480 monitors or overhead LCD projectors. Fast, HI-RES drivers for all major applications are provided, including a Display List Driver for Autocad.

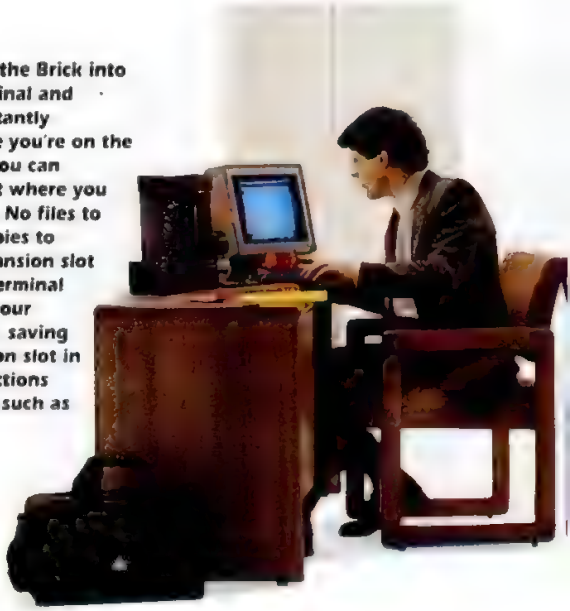
Good to Go

The innovative Ergo design provides perhaps the best benefit—versatility. You can use the same Moby Brick as a fast, quiet, stylish desktop at each of your regular destinations, such as your home and office. The optional Docking Terminal provides instant hook-up of all cables as well as a second 16-bit 3/4 length

6:25 a.m. You can start your day before heading to the office. An hour of quality work time before the onset of office interruptions (or at home in the evening) can be the most productive time of your day. With up to 510 MB of storage you can keep everything with you. All your files, addresses, even the ones you didn't think you needed, are at hand.

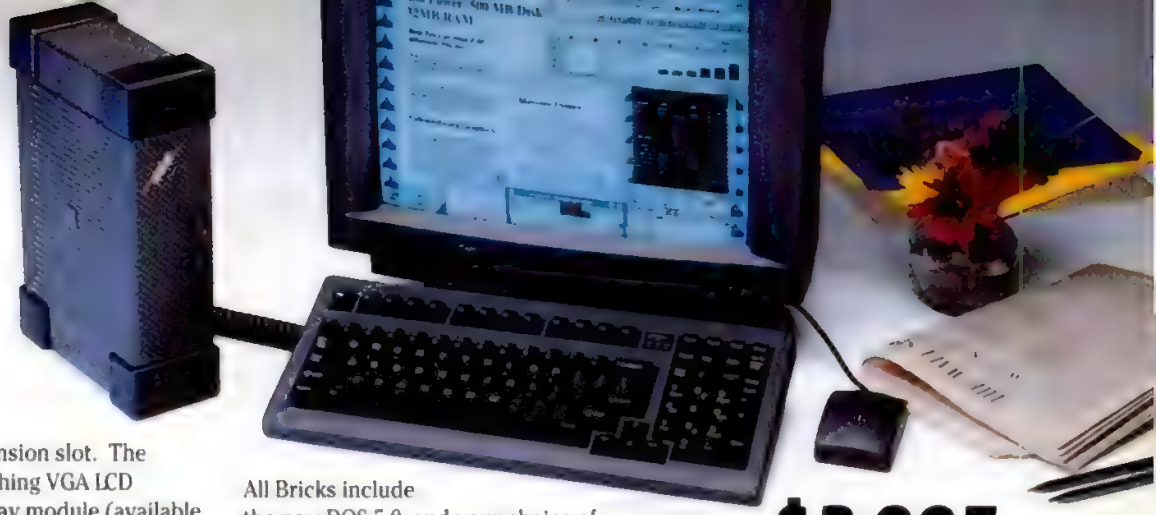


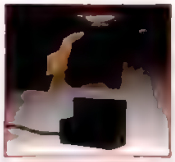
8:35 a.m. Drop the Brick into its Docking Terminal and everything is instantly connected. Since you're on the same computer you can immediately start where you left off at home. No files to transfer, no floppies to switch. The expansion slot in the Docking Terminal can be used for your network adapter, saving the internal option slot in the Brick for functions you need off-site such as a fax board.



MVP 1990 FINALIST

33-1-47917100 | 49-8142-50031 | 44-602-452228 | 41-22-621572





expansion slot. The matching VGA LCD display module (available in August) turns Moby Brick into a portable, go anywhere solution. The LCD features a 64 gray scale controller and the latest Sharp thin film, super twist, backlit LCD technology.

Innovative Software

The Brick's system software has features not available in any other PC. (You might expect this from Ergo, since we're a leader in DOS Extender software with customers like Borland, Fox, and Cadam.) This includes a reprogrammable BIOS with user tunable keyboard control, password protection, and non-volatile owner identity. Updates to the latest release are just a phone call away. This BIOS also includes an integrated disk cache that is significantly faster than add-on software caches. System and video shadow RAM are provided, plus a (192K) block of high memory above 640K for loading high TSRs, networks and other resident utilities.

All Bricks include the new DOS 5.0, and your choice of Windows 3.0 plus Adobe ATM with 13 fonts, a Logitech mouse *or* DESQview/386 with QEMM. Whichever environment you choose, your Brick will come fully set up, fine-tuned and ready to go. There's even on-line Hypertext manuals for the Brick and DOS. All Bricks are 100% IBM AT-compatible and support DOS, OS/2, UNIX, X/Windows and Novell.

Factory Direct Value

Bricks are available directly from Ergo—the same people who design, manufacture and support them. As a result, they sell for very attractive prices. However, a good deal is only one of the reasons you'll enjoy doing business with Ergo. We offer unlimited toll-free technical phone support, overnight repair service, a one year warranty and a no nonsense, 30 day satisfaction guarantee.

Call **1-800-633-1925** to order your Brick today or for information on the complete Ergo product line (8 a.m. to 8 p.m. EST.) For immediate information via FAX (24 hrs) call **1-800-The Brick.**

$3,995

486SX MOBY BRICK

20 MHz Intel 486SX
4 MB RAM, exp to 32 MB
120 MB 19ms cached hard disk

intel inside

$4,995

486DX MOBY BRICK

33 MHz Intel 486DX
4 MB RAM exp to 32 MB
120 MB 19ms cached hard disk

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20 MHz Intel 386SX
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Standard Features (Brick and Moby Brick)

- 1024 x 768 Super VGA adapter supports EGA, CGA, MDA monitors
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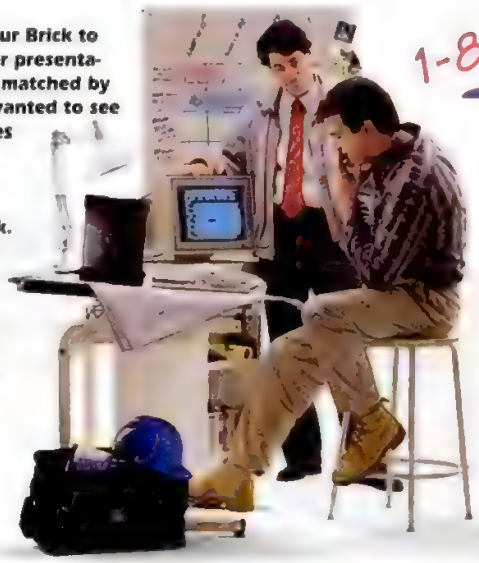

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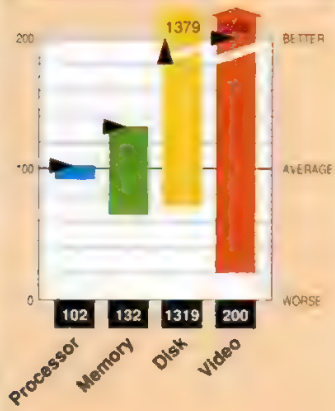
TANGENT MODEL 425E

TEST RESULTS



In Short: The $6,284 Tangent Model 425e, a tower unit, boasts a Mylex SCSI controller with 1MB of RAM, which contributed to its remarkable disk test score. The system was one of the leaders on our processor test and had a top-notch memory score. It contains the same Sigma video board as its smaller sister, which again performed well. Tangent offers extensive customization options, but most users should be more than happy with the configuration of either the ISA or the EISA version.

> If you feel the future belongs to EISA, then consider bypassing the 425e and spending $500 more for Tangent's 486/33 EISA.

If you are looking for performance contrasts between the two Tangent models to help you make your decision, you won't find many. Both systems turned in excellent test results across the board. The Model 425e's test results were excellent, neither better nor worse than the Zeos contender. It was one of the leaders on the processor test and had a better memory score than the Zeos EISA machine.

On the other hand, the Tangent machines' Maxtor hard disks and Sigma Designs Legend Plus video cards put in slightly slower times than that of the Zeos PC. Since Tangent will configure a system to your specifications, you can improve both the video and disk results. In fact, Tangent's customization options are extremely flexible and detailed. For example, Tangent uses the Sigma video adapter so that it can customize that card by changing the DAC (digital-to-analog converter). The company lets you choose an Edsun or Sierra chip. The big difference between them is that the Edsun has superior anti-aliasing, eliminating jagged edges. However, it isn't capable of 1,024-by 768-pixel noninterlaced resolution. The Sierra DAC is capable of 1,024-by-768 noninterlaced resolution and is Targa file compatible.

Tangent machines are available through dealers and through the mail, and Tangent blankets its systems with a 30-day unconditional return policy, a one-year parts-and-labor warranty (two years on the Mylex controller and EISA board), standard on-site service from TRW, and toll-free tech support for the life of the system. The company also says that it now maintains a database with customers' system configurations on file in order to address specific difficulties.

The only difficulty you may encounter is deciding exactly what to buy. The mini-tower Tangent Model 425i compares favorably with other systems in its class in terms of both price and performance. Its Sigma video performance is a certain draw for those with CAD requirements. For another $500, you can get the full force of a 33-MHz 80486 in the ISA configuration—quite a bargain.

On the other hand, if you feel the only future is an EISA future, then consider bypassing the Model 425e and making an additional $500 investment for Tangent's $6,779 33-MHz 486 EISA model—a superior arrangement for LAN applications. Whether you are interested in private graphics pursuits or public network needs, Tangent has a 486 for you.

TENEX COMPUTER EXPRESS

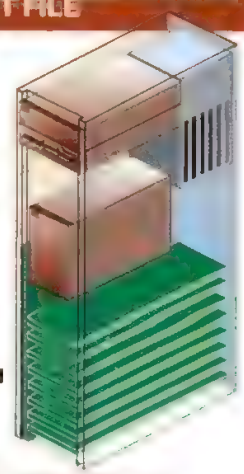
Tenex 486 Power Column

by Greg Pastrick

Given the unfavorable reviews of the performance of 80486-based PCs with DTK motherboards and components, a nod in favor of the Tenex 486 Power Column might seem surprising. But our findings in this case are supported by two of the Power Column's most appealing, non-performance-related features: its FCC Class B certification and its reasonable price. These mark the Tenex as a machine that home users can afford without mortgaging the home.

$3,724 buys a 16-bit ISA machine matching our standard configuration, including 8MB of RAM, 64K of external

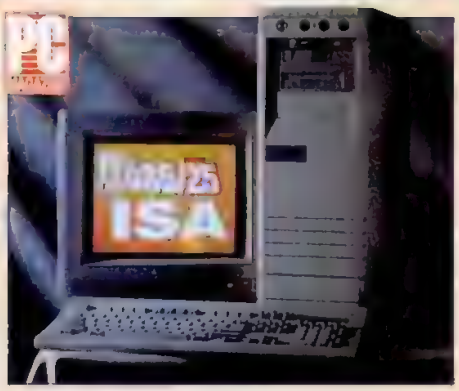
FACT FILE

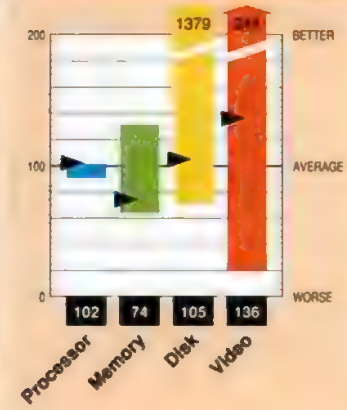


Tenex 486 Power Column
Tenex Computer Express, 56800 Magnetic Dr., Mishawaka, IN 46545; 800-776-6781, 219-259-7040.
List price (tested configuration): $3,799.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 64K cache.
Disk drives and controller: Western Digital 14-ms. 210MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Boca Research 1,024 by 768 adapter with 1MB RAM, Samtron 14-inch monitor.
Software: DOS 4.01.

CIRCLE 425 ON READER SERVICE CARD

TENEX 486 POWER COLUMN





In Short: Slow memory performance can almost be overlooked in a sub-$4,000 25-MHz 486. This DTK-based PC's FCC Class B rating makes the unit appealing as well. With its 210MB Western Digital 3.5-inch hard disk, the Tenex 486 Power Column turned in the fastest disk timing of any noncached 16-bit ISA machine we reviewed, and when EISA systems are factored in, its performance was still slightly above average. Price and the FCC rating tip the balance and make this an attractive prospect.

processor RAM cache, a 210MB hard disk, a 1.2MB or 1.44MB floppy disk drive, and a Super VGA display subsystem. The system we tested adds $75 to the price for a second floppy disk drive. To go two better, Tenex sells an identically configured 33-MHz 80386 version for $600 less. By comparison, a stripped-down 486/25 Tenex system that comes with 4MB RAM, a lone 1.2MB floppy disk drive, an amber monochrome monitor with a Hercules graphics card, and a tower case sells for $2,699.

Our processor test shows the Power Column running slightly above average in our test group. Conventional Memory testing ties the Power Column with the second-slowest of the group, though its Western Digital Piranha 4200 IDE hard disk (coupled to a DTK IDE controller card) and the Boca Super VGA controlled display system produced comfortably above-average timings. The DOS File Access score was the fastest time we recorded for a noncached machine in the group.

STEADY BUT NOT STABLE

The DTK Feat-2502 system case and PKM-2500 motherboard are acceptably expandable. The tower configuration accommodates five half-height drives—three horizontally and two vertically. Our tested system's 3.5-inch hard disk was held in one of the vertical half-height slots by extension mountings. With the cover on, the case is steady enough, but—as with the cover of the old AT case—remove it and the top and bottom of the machine go with it; this makes for an unstable stand-up machine.

An internal brace fights any flex in the eight-slot motherboard. Once the PC is open, the sockets for the 8MB of 80-nanosecond SIMMs (expandable to 16MB) are easily reached, as are the 25-ns. DIPs forming the direct-mapped 64K processor RAM cache (expandable to 256K).

Tenex offers a full line of hardware, software, and accessories. Among the software is *Microsoft Windows* 3.0 ($99.95), *CheckIt* 3.0 for system setup and diagnostics ($119.95), *Super PC-Kwik* disk-caching and memory-management software ($58.95), and *QEMM-386* ($84.95). Tenex offers a list of hard disks, from a 80MB IDE drive ($439) to a 676MB ESDI drive ($1,995). The company also sells a 700MB internal tape drive for $899. Tenex supports its systems with a one-year warranty on parts and labor, toll-call telephone support, and standard on-site service by TRW.

Although its memory performance is slow compared with that of the other units in this roundup, the Tenex 486 Power Column offers sound features at a thoroughly competitive price. Add solid service and FCC Class B certification, and you're looking at a reasonable buy.

TREASURE CHEST SYSTEMS INC.

Treasure Chest TC 486-25

by Henry Fersko-Weiss

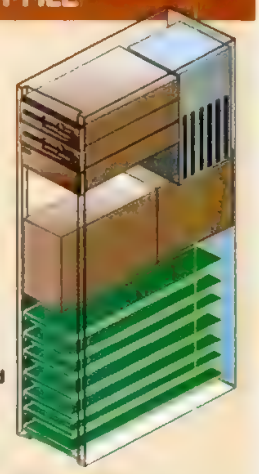
The Treasure Chest TC 486-25 uses the DTK motherboard and tower case, making its looks and processor performance just about indistinguishable from the DTK Feat-2502, another 486/25 machine reviewed in *PC Magazine*, June 11, 1991. But the present ISA-bus 25-MHz 486 employs different peripherals, and its 256K external processor RAM cache surpasses the 64K in the DTK machine. Of the three units using the DTK motherboard in this roundup, the TC 486-25 is the least expensive and provides the most bang for the buck.

In *PC Magazine*'s standard configuration, the TC 486-25 costs only $3,699, with 8MB of RAM, a 211MB hard disk, a 1.2MB or 1.44MB floppy disk drive, and a Super VGA subsystem. The unit we tested came with a 256K processor RAM cache and both 1.2MB and 1.44MB drives, for a cost of $3,995.

TOUGH OPENER

Although the TC 486-25 is set up as a traditional tower, you have to lay it down on one side like a desktop unit to open it up. Inside, you will find three half-height

FACT FILE

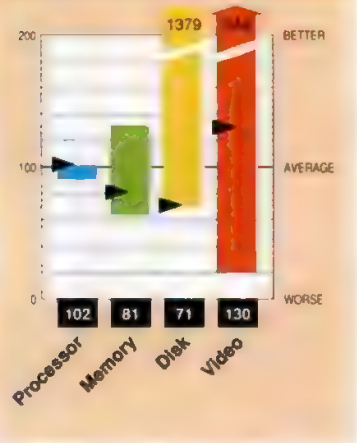


Treasure Chest TC 486-25
Treasure Chest Systems Inc., 4668 Portrait Lane, Plano, TX 75024; 800-245-3040, 504-468-2010.
List price (tested configuration): $3,995.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Seagate 15-ms. 211MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Seiko 14-inch monitor.
Software: DOS 4.01.

CIRCLE 428 ON READER SERVICE CARD

TREASURE CHEST TC 486-25

TEST RESULTS



In Short: The Treasure Chest TC 486-25 produced mixed test results. Its DTK motherboard, with an Intel chip set, had a better-than-average processor score, but its 80-nanosecond page-mode RAM turned in a below-average memory score. The Orchid ProDesigner II video card produced a typically strong score. Yet the disk score was bottom-rung; this Seagate IDE hard disk has performed poorly in past reviews. Consider this system for its FCC Class B certification and low price.

FACT FILE

Touche 5550T/486-25
Touche/PC Pros, 8205 S. Cass Ave., Darien, IL 60559; 708-810-1010.
List price (tested configuration): $4,599.
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 128K cache.
Disk drives and controller: Maxtor 20-ms. 361MB ESDI, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Sony 13-inch monitor.
Software: DOS 4.01.

CIRCLE 426 ON READER SERVICE CARD

drive bays, accessible from the front. Below them is the housing for two more half-height drives; another half- or full-height drive can be mounted on an internal support bracket. In our tested unit the 211MB Seagate hard disk was mounted in this back position, making it impossible to reach the system's SIMMs unless you remove a controller card (which controls the floppy disk drive and I/O) from the slot just below the drive, and then pry the drive bracket and housing loose.

The system's SIMMs are of the relatively slow 80-nanosecond variety, but the 256K processor RAM cache uses 25-ns. SRAMs. The unit performed slightly better than average on PC Magazine Labs' processor test but was somewhat slower than average on the memory test, in part because of those 80-ns. SIMMs.

The TC 486-25's Seagate ST1239A IDE hard disk fared the worst in this group. It took about 10 percent longer than the DTK Feat-2502's 200MB IDE hard disk. In case you need better performance, Treasure Chest offers a number of hard disk options, up to 1.05GB. The TC 486-25's video test result was better than average, though a bit slower than usual for an Orchid controller.

If you want a computer with FCC Class B certification, the Treasure Chest TC 486-25 makes sense provided that you choose a different hard disk. But an even better choice may be Treasure Chest's 486 33-MHz machine, which costs about $500 more in our standard configuration (though it has yet to achieve Class B certification). In any case, if you are considering a 486 with a DTK motherboard, the TC 486-25 is a better choice than either the DTK Feat-2502 or the Tenex 486 Power Column, and it costs less.

TOUCHE/PC PROS

Touche 5550T/486-25 Touche 5550T/486-25E

by Kellyn S. Betts

The monikers of Touche/PC Pros' ISA and EISA machines do little to distinguish one from the other. But there are many similarities between the two 5550T/486-25 machines, including their first-rate features.

The ISA system's $3,949 price in *PC Magazine*'s standard configuration is a little lower than the average price for its peers. The EISA unit's $4,949 price tag is the typical $1,000 more than its ISA sibling, but the system is also available in a smaller case for $4,549, which makes the margin quite narrow. Both EISA prices are low compared with those of the other EISA machines in our roundup. In fact, the 5550T/486-25E is the lowest-priced EISA computer we reviewed.

The systems we actually tested cost a bit more, but only because Touche put more than the usual complement of blue-chip components inside them. The company's systems always include two floppy disk drives (one more than our standard configuration requires), two parallel and two serial ports (one more parallel port than we demand), DOS 4.01, and video subsystems composed of Orchid ProDesigner Plus cards and Sony CPD 1304 monitors. The ISA system comes with a 128K external processor RAM cache, the EISA with a 64K external processor RAM cache. To this impressive collection of components, Touche has added a 361MB hard disk to each, bringing the tested ISA system's price to $4,599. An extra-cost case option brought the price of the EISA system to $5,399.

Both machines carry an FCC Class B certification, like all machines sold by Touche. This certification reflects the attention to detail that goes into each machine. Touche machines also come with their internal components and cables clearly labeled. And the company's service and support policies are nothing short of excellent: one year on parts and labor (plus any additional component part warranties), backed by telephone service with overnight parts shipping, on-site service through TRW, and an 800 phone line for technical support.

"THE MOST POWERFUL COMPUTERS ARE THE ONES PEOPLE ACTUALLY USE."

—Apple Computer

First off, let's get one thing straight. We totally agree with Apple.* A truly powerful computer is measured in how often it's used.

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Virtually every feature you can find on a desktop computer, you will find on the T2000SX: An 80386™SX processor with a math coprocessor socket, VGA compatible display, 1 MB (expandable to 9MB) of 80 nsec RAM, a 40 MB hard disk with 19 msec access time and 1.5 MB/sec data transfer rate.

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Because the T2000SX can fit easily into a briefcase (it weighs a scant 6.9 pounds), you can take it anywhere you go and use it in more ways than you can imagine.

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Our internal AutoResume back up battery automatically saves your work if your main battery runs out.

business proposal? The T2000SX gives you the freedom to do it from a train. The client wants an estimate on costs? You can give it to him right then and there—wherever there is.

No more wasting time running back to the office. Because the office is always with you.

But just in case there's something back at the office you still need, you can get back to it with our optional built-in modem. Which supports industry standard error corrections and data compression (CCITT V.42, V.42bis, MNP® 5). It even supports cellular data communications via our optional smart cable adapter.

Our user-installed memory card allows you to add up to 8 MB of memory yourself.

The T2000SX also has a unique feature you won't find on any other computer in the world. It is called AutoResume.

AutoResume: Think of it as a bookmark for your computer.

AutoResume automatically saves whatever you're working on whenever you turn the computer off. And it lets you go directly to the program you were using last when you're ready to start up again. So you don't have to reboot, restart your application and reload your files.

AutoResume also helps save on battery life and it allows you to change batteries without losing an ounce of information.

The T2000SX comes complete with Hypertext on-line documentation.

As for batteries, the T2000SX touts the latest in battery technology —Nickel Hydride. Nickel Hydride delivers 22% more watt-hours per pound than NiCad and it doesn't suffer from memory effect.

In keeping with the Toshiba tradition, the T2000SX also offers superior ergonomics. Like full-size, standard-spaced keys on a keyboard which has a full set of 12 dedicated function and 8 cursor control keys. And a VGA compatible, reversible black on white or white on black high resolution display.

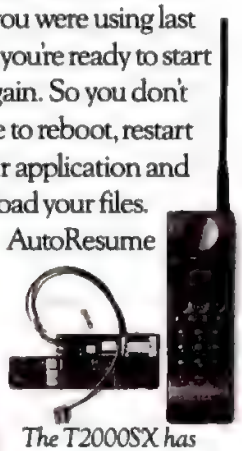
Okay, let's wrap this thing up.

These are just a few of the reasons why we believe the T2000SX is the most useful, and therefore, most powerful computer in the world. And why P.C. Week* Labs said, "*the T2000SX offers performance comparable to the LTE 386s/20, plus many of the design features that have made Toshiba a market leader in portable PCs.*" PC WEEK

We invite you to learn more about the T2000SX and Toshiba's best-selling line of portable computers by calling us at **1-800-457-7777** for a complete information kit.

In closing, we'd like to thank you for reading our ad.

We'd also like to thank our friends at Apple for giving us such a wonderful endorsement.

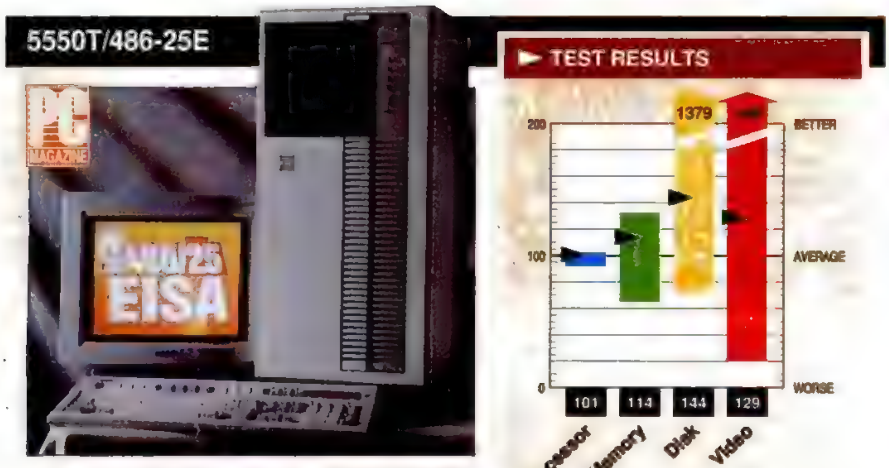


The T2000SX has an optional modem that allows data communications via a cellular phone.

In Touch with Tomorrow

TOSHIBA

CIRCLE 379 ON READER SERVICE CARD



In Short: At $5,399, the Touche 5550T/486-25E is priced very inexpensively for an EISA machine. Its blue-chip list of components (including a 361MB hard disk with caching disk controller, an Orchid ProDesigner Plus card, and a Sony CPD 1304 monitor) make it even more attractive. The computer's competitive performance on our tests, coupled with its jumbo case and power supply and FCC Class B rating, makes it a truly formidable offering.

CASE DIFFERENCES

Despite these similarities, the 5550T/486-25 and 5550T/486-25E we reviewed looked nothing alike because they were housed in dramatically different cases. The ISA 5550T came in a standard-sized tower case with eight slots (five of which were available in our tested system) and six half-height drive bays (three of which were free). Unlike other PCs in our roundup that include 180- to 220-watt power supplies, Touche includes a 300-watt power supply from PC Power & Cooling—one of the factors to which Touche attributes its Class B certification. Touche actually sells its EISA system in the same case and configuration for an unbeatable $4,999 (in this case, the EISA machine has the same five slots and three bays free as its ISA counterpart).

The EISA unit we were sent for review was hidden inside a $400 option: a mammoth, wheeled tower case with room enough for six full-height drives (only five half-height drives without extra braces added) and eight 32-bit slots. Our tested unit had five free slots and four free full-size bays, along with the heavy-duty 475-watt power supply and two fans.

Although this big case has obvious advantages, there are also some disadvantages. For example, the AMI motherboard's position prevents the topmost slot from holding a full-length expansion board. And two of the bays—including the one behind the main cage of drive bays, containing the 20-millisecond Maxtor ESDI hard disk—are not easily accessible. This large case does not have a reset switch or turbo switch, although it does have LEDs to show the activity of two hard disks, a tape streamer, and COM1.

Judging from their performance on our benchmark tests, the EISA machine could work admirably as a server, while the ISA system would make a fine workstation. Both machines' performance compared well against the other computers in their respective bus classes. Neither machine is as good a deal as its 33-MHz counterpart, however: You'll pay only $400 more for an identically configured 486/33 of either architecture. That works out to less than 10 percent more price for about 25 percent

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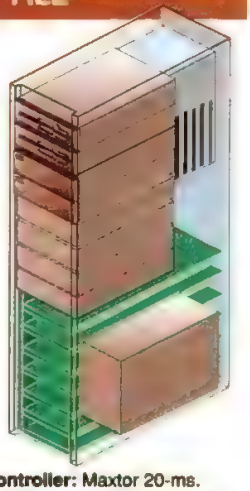
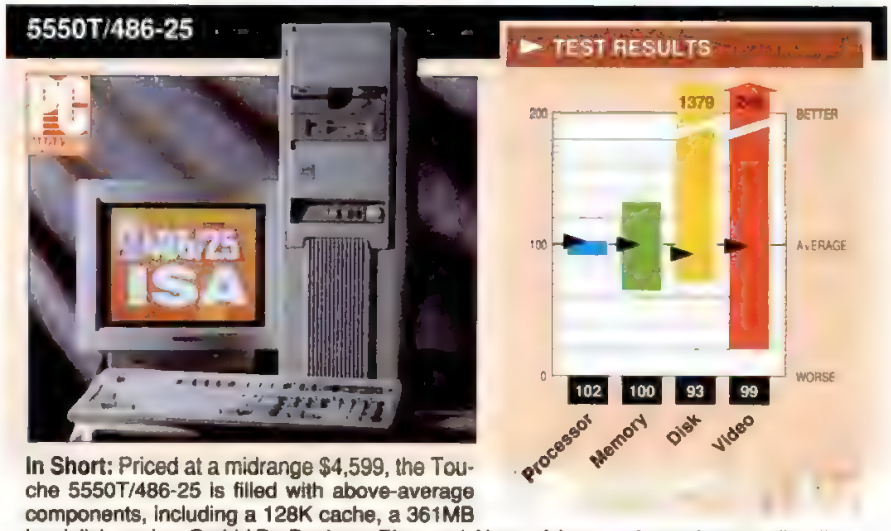


Touche 5550T/486-25E
Touche/PC Pros, 8205 S. Cass Ave., Darien, IL 60559; 708-810-1010.
List price (tested configuration): $5,399.
Memory and processor RAM cache: 8MB 60-ns. SIMMs, 64K cache.
Disk drives and controller: Maxtor 20-ms. 361MB ESDI, UltraStor controller, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Sony 13-inch monitor.
Software: DOS 4.01.



In Short: Priced at a midrange $4,599, the Touche 5550T/486-25 is filled with above-average components, including a 128K cache, a 361MB hard disk, and an Orchid ProDesigner Plus card. None of them performed extraordinarily on our tests, though the processor score was quite good. The only aspects that make this ISA machine stand out are the internal cable labeling featured in all the company's products and the FCC Class B certification.

CIRCLE 427 ON READER SERVICE CARD

better processor performance.

The Touche 5550T/486-25 ISA machine is a good buy for the quality of its performance, components, service and support. Teaming up the same attributes with a more competitive price makes the Touche 5550T/486-25E an outstanding EISA offering. But despite their value, you should consider these machines only if you are sold on 25 MHz, as both machines' 33-MHz counterparts offer even more attractive prices.

ULTRA-COMP

Ultra-Max 486-25

by John Blackford

The Ultra-Max 486-25 is a moderately priced desktop PC suitable for the full range of business computing. Combining components from recognized manufacturers with a good service policy and competitive pricing, the Ultra-Max offers good value for small business owners as well as for corporate users who need 486 power.

In *PC Magazine*'s standard configuration—with 8MB of RAM, a 256K external processor RAM cache, a 200MB hard disk, one floppy disk drive, and a Super VGA video subsystem—an Ultra-Max 486-25 costs $4,545. The unit includes *Windows* 3.0 and a Microsoft serial mouse. In our tested configuration, with two floppy disk drives, it costs $4,595. Though Ultra-Comp sells primarily by direct mail, the company does work with a small number of dealers and VARs. Ultra-Comp also offers leasing plans.

The Ultra-Max is an average-sized desktop machine with five 16-bit expansion slots available. The other three slots are used by the video, I/O, and floppy disk controllers. There are three accessible half-height drive bays and two half-height internal bays.

PREMIUM CLONE

The Ultra-Max is well constructed, using name-brand parts such as a Micronics motherboard with Phoenix BIOS, a Maxtor IDE hard disk, an Orchid ProDesigner II video board with 1MB of video RAM, and a Sony Trinitron 1,024-by-768 monitor. It could be termed a premium clone, with quality parts and plenty of included extras, yet its price is well below average.

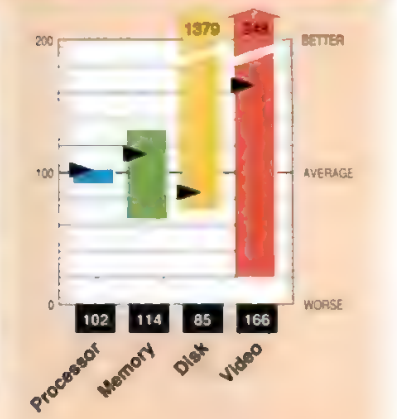
The Ultra-Max was among the fastest machines on PC Magazine Labs' processor and memory tests; it also delivered above-average response on our video test. Only its disk performance fell slightly below average, possibly thanks to its IDE drive controller. With its 256K RAM cache, the computer might have moved away from the pack in all other categories had it come equipped with 60-nanosecond or 70-ns. RAM instead of the 80-ns. SIMMs installed.

The Ultra-Max's documentation consists of books and pamphlets from the various component manufacturers. In line with the quality of the individual parts, these manuals are complete and well organized. Ultra-Comp also provides a useful manual of its own describing setup and operation.

Ultra-Comp offers strong provisions for service and support. There is a one-year warranty on parts and labor, with on-site service provided by TRW. (A second year of on-site service costs $179.) You first call a toll-free support line, where the staff tries to solve your problem or identify the malfunctioning part. Once troubleshooting is complete, Ultra-Comp ships out a replacement part at its expense for you to install (if you are willing), or else it dispatches TRW to make the repair. You then return the defective part, again at Ultra-Comp's expense.

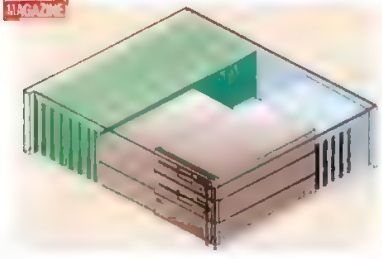
Ultra-Comp also offers a 30-day money-back guarantee. An unsatisfied customer can return the computer in original condition for a full refund, with no restocking fee; the customer pays only for the return shipping. Ultra-Comp's Ultra-Max 386-33, with only 4MB of RAM and a 64K cache, costs $3,495, or $1,100 less than the Ultra-Max 486-25. Taking into account the difference in RAM and cache, this works out to roughly a $600 premium

ULTRA-MAX 486-25



In Short: The Ultra-Max 486-25 is a deal at $4,595, given its excellent components, good performance, and on-site service. The 256K cache, 1.2MB and 1.44MB floppy disk drives, *Windows* 3.0, and Microsoft Mouse make a good deal even better. Only the IDE hard disk keeps this unit from being a runaway top performer; along with 15 other systems, it registered a disk test score of more than 60 seconds.

FACT FILE



Ultra-Max 486-25
Ultra-Comp, 11988 Dorsett Rd., Maryland Heights, MO 63043; 800-435-2266, 314-991-0437.
List price (tested configuration): $4,595.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 256K cache.
Disk drives and controller: Maxtor 15-ms. 200MB IDE, 1.2MB and 1.44MB floppy disk drives.
Display: Orchid ProDesigner II Super VGA adapter with 1MB RAM, Sony 13-inch monitor.
Software: DOS 4.01, *Windows* 3.0 with mouse.

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for the 25-MHz 80486 processor. Either machine is a good value. Ultra-Comp's EISA-bus Ultra-Max 486-33, with 4MB RAM and a 128K cache, costs $1,250 more than the 25-MHz 486 unit.

Although the Ultra-Max 486-25 is not the least expensive PC we tested, it is among the cheapest. With its standard extras, quality components, decent performance, and on-site service, it is a good value.

UNISYS CORP.

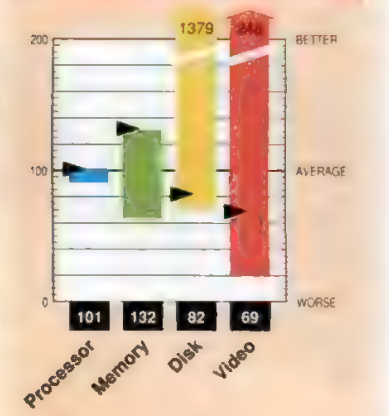
Unisys PW2 800/486-25A

by Patrick Honan

It is easy to rate a computer on its specs: factors such as speed, open expansion slots, and price. Just as important are intangibles, such as the company's experience and its ability to sell a complete office solution, not just a box with a processor, hard disk, and RAM. The Unisys PW2 800/486-25A is a fair performer when rated on its specs, and it gets even higher marks for the intangibles.

In our tested configuration, this ISA system sells for $15,203 and includes 8MB of RAM, a 340MB hard disk, one 1.2MB floppy disk drive, a Super VGA display subsystem, and *Microsoft Windows* 3.0. Unisys also sells a 170MB SCSI hard disk, which brings the price down to $14,153. The company sells through computer dealers and a direct sales force, and you should find prices discounted through both channels.

UNISYS PW2 800/486-25A



In Short: When fast hard disk or video performance is important, the Unisys PW2 800/486-25A falls short of the mark. Its strength is in the products and support Unisys offers for a networking environment. The 14-millisecond Seagate disk and Adaptec SCSI controller scored in the bottom quarter of systems on our disk test, and the Western Digital Super VGA card had one of the slowest times on the video test. With fast memory, it is a better bet for applications involving lots of CPU access.

INTANGIBLES

What intangibles do you get? For starters, Unisys sells networking cards and SCO Xenix System V, and it is an authorized reseller of Novell's *NetWare* products—factors many other manufacturers don't match. Granted, you can purchase these products from a third party, but there are obvious advantages to getting everything from one source. For example, this system manufacturer guarantees that the networking products will work with the computer.

Another intangible is Unisys's four-level support plan. The options range from a $25-per-month plan, which includes telephone support and access to a technical support bulletin board service, to a $70-per-month plan, which includes on-site maintenance by Unisys. You can negotiate other plans tailored to your specific needs. If you just want basic telephone support, lots of manufacturers provide adequate service, free of charge. But the price of the more advanced levels of support could be money well spent if the PW2 is to act as server to dozens of your employees.

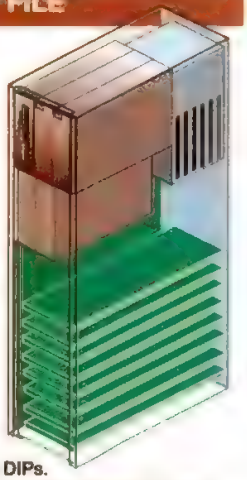
TANGIBLES

In other respects, the PW2 is an average performer. Inside the 21- by 6- by 19-inch case are five half-height drive bays, three of which are accessible from the front. The Intel motherboard has four 32-bit proprietary slots for memory expansion, allowing you to install the system maximum of 32MB of 80-nanosecond interleaved RAM, which will come in handy only in a network environment. There are also three 16-bit slots and one 8-bit slot.

This Unisys machine's memory slots can accept 16-bit expansion boards as well. In the tested unit, a memory board and an Adaptec SCSI hard disk controller occupied two 32-bit slots, and the Western Digital Super VGA board occupied a 16-bit slot. The parallel port, two serial ports, and a PS/2-style mouse port are built onto the motherboard.

Our tested unit had no RAM cache beyond the 8K built into the 80486 processor: The SCSI hard disk controller had no buffering or cache; and Unisys does not offer either as an option. Lack of a RAM cache did not hurt the PW2's time on the processor test, but the computer did place in the bottom quarter on PC Magazine Labs' disk test, despite the 14-millisecond rated speed of the Seagate hard disk. On the other hand, the PW2 tied with two other machines for the fastest time on the memory test. The Super VGA controller, however, performed in the bottom quarter

FACT FILE



Unisys PW2 800/486-25A
Unisys Corp., Township Line and Union Meeting Roads, Blue Bell, PA 19424; 215-986-3501.
List price (tested configuration): $15,203.
Memory and processor RAM cache: 8MB 80-ns. DIPs.
Disk drives and controller: Seagate 14-ms. 340MB SCSI, Adaptec controller, 1.2MB floppy disk drive.
Display: Western Digital 512K Super VGA adapter, Unisys 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

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Display	*VGA Sidelit CCFT* *Paper White VGA LCD* *256KB Video RAM* *64 grey shades support*	*VGA Edgelit LCD* *16 grey shades support*
Keyboard	*Standard AT-compatible* *3mm key travel depth*	*Enhanced keyboard* *2.5mm key travel depth*
Memory	*1MB expandable to 5MB*	*2 MB expandable to 10MB*
Software Incl.	*Laplink III* *MS-DOS* *Windows 3.0*	*Not available*
Support	*Toll-free 800 number* *On-line modem support*	*Not available*
Price	*20MB - $3999* *40MB - $4499*	*30MB - $6499* *60MB - $6999*

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FAST FACTS: Slim*Lite* is made for easy toting. A nifty 11.7" x 8.25" x 1.9", it tucks easily in your briefcase. Plenty of room for extra batteries, AC adapter, mouse PLUS your business essentials.

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Turn on Slim*Lite* and settle back for the most enjoyable portable computer experience of a lifetime.

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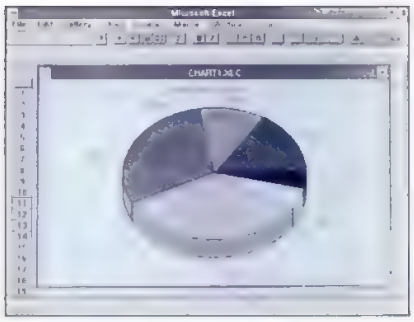


SLIM*LITE* DOUBLES AS A DESKTOP! Neat Trick. Unique Northgate holder lets you set up Slim*Lite* as a desktop "mini-tower." Slide it into the optional stand, connect your full size keyboard and monitor and printer. Presto! You have a powerful desktop computer. You can even communicate around the world with the optional 2400 baud internal modem.

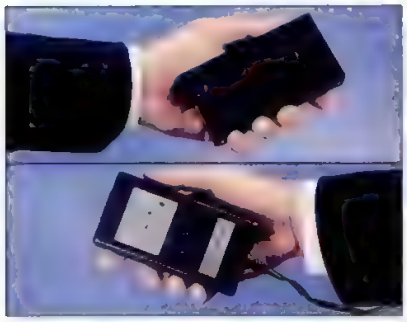
TEST SLIM*LITE* RISK FREE! Order Slim*Lite* now and give it a workout for 30 days. If Slim*Lite* doesn't deliver everything you expect, return it. We'll buy it back for every penny you paid. No questions. No hassles. We're betting that once you use Slim*Lite*, you won't want to be without it.

KEYBOARD CAUTION: Before you buy a notebook check out the keyboard. Beware those that have lots of FN key functions. Many systems require using these in conjunction with other keys. They substitute for separate keys.

Excessive FN key use slows down your typing, can be confusing and downright aggravating.

Slim*Lite* has separate PG UP, PG DN, HOME and END keys ... And independent inverted "T" cursor keys. You'll feel like you're typing on your office desktop.

The typing keycaps are full size and comfortable. Keyboard quality you expect only of Northgate.



TOP: Rechargeable Ni-Cad battery weighs 1.05 lbs
BOTTOM: "AC Pack," tiny and weighs well under a pound

POWER E-X-T-E-N-D-E-R: You'll get an amazing two and a half hours of continuous real time work with Slim*Lite*. Ingenious power-down feature saves energy, lets you resume working where you stopped. The rechargeable battery is a wondrous power module, one of the smallest, lightest ever made. Two of them will get you through a coast-to coast flight. Slim*Lite* recharges WHEN in use with AC adapter. External battery charger available.

Northgate Slim*Lite* Features:

- System dimensions: 11.7" x 8.25" x 1.9"; battery: 4.87" x 2.73" x 0.68"; AC adapter: 5.32" x 2.71" x 1.75"
- System weight 6.1 lbs with battery; AC adapter 0.8 lb.; battery 1.05 lbs.
- 84-key keyboard emulating 101
- 9" diagonal LCD screen; supports 32 shades of gray; VGA 640 x 480
- 386SX 20MHz processor
- 80387SX coprocessor support
- 3MB RAM; expands to 5MB
- 20MB hard drive with auto parking; 40MB and 60MB drive options available
- 1.44MB 3.5" floppy drive
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- External VGA monitor and keyboard ports
- 9-Pin serial port; parallel port
- Supports internal 2400 baud modem (optional)
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RIGHTSIDE UTILITIES: The 1.44Mb 3.5" floppy drive is positioned where it should be — up front — for easy use. To charge battery or to use AC power, plug the adapter into the jack provided. It's in back to keep cords out of your way.

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And it's no coincidence that these drives are named Swift: every drive in the family boasts a 15 msec. average access time. They also feature Seagate's proprietary thin-film discs, spindle motors, rotary voice coil actuators and patented dedicated servo technology for maximum performance and reliability.

No one knows more about the fine art of disc drives than Seagate. For complete product specifications, contact your authorized Seagate distributor, or call Seagate directly: 800-468-DISC, or 408-438-6550. But don't delay; like their name, these drives are bound to go fast.

ANOTHER QUALITY PRODUCT Seagate

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of all systems on our video test.

These mixed results should not detract from the PW2's other advantages. This is the top of the Unisys line, so if you're willing to pay a premium for reliability, a full range of networking options, and prompt service and support, the Unisys PW2 800/486-25A is a good buy. But if you measure a system on a strict price/performance ratio, there are better 486 computers from which to choose.

ZEOS INTERNATIONAL LTD.

Zeos 486-25C

by Mario Baldasserini

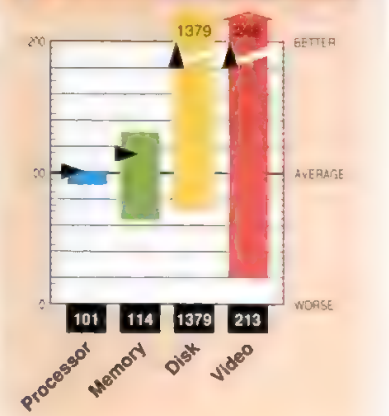
Zeos International, a mail-order company, has proven time and again that quality and performance are essential parts of the Zeos computer. The Zeos 486-25C EISA is an extension of this philosophy.

Configured to match *PC Magazine*'s standard configuration, with a 200MB IDE hard disk and one high-density floppy disk drive, this machine is impressive at $5,890. The Zeos 486-25C we tested lists for $7,645, including a 312MB hard disk and Mylex SCSI caching controller, which will control two drives with complete Western Digital compatibility or seven SCSI devices with SCSI drivers. A Diamond SpeedSTAR card and Zeos VGA monitor handle the video chores. The Turbo Cool 450 power supply gives the Zeos 486-25C its power to fly. Also included in the package were *Windows* 3.0 and a Microsoft Mouse.

The Zeos 486-25C is built for speed, and it proved itself on our processor test thanks in part to the 128K on-board processor cache. Most notable, however, were the disk and video performance. The 17-millisecond Seagate disk exhibited excellent performance with its 32-bit Mylex DCE 376 SCSI caching controller. This controller came with 1MB of cache and can be configured to support 2MB, 4MB, 8MB, or 16MB of cache. The Diamond SpeedSTAR VGA with its 1MB of RAM achieved an impressive video test result.

The Zeos comes in a large tower case measuring 24.5 by 7.5 by 17.5 inches. It can hold six 5.25-inch half-height drives and two 3.5-inch drives. The front of the case houses the reset switch and the turbo switch, which changes the processor speed from 8 MHz to 25 MHz. It also has an LCD indicator for high or low speed and the keyboard lock.

ZEOS 486-25C



In Short: The Zeos 486-25C's first-place disk score was due largely to the 32-bit Mylex bus-mastering controller, which comes with 1MB of on-board cache and a processor. The Diamond SpeedSTAR VGA card got an even better score than those normally associated with the Tseng Laboratories chip set. Processor and memory test numbers were also among the best we saw. This tower machine allows for expansion and power, with quality components at a reasonable price.

The Zeos 486-25C comes with a Mylex motherboard, with 128K cache standard, and runs at zero wait states within the cache. The motherboard supports 256K, 1MB, or 4MB SIMMs, which give the computer a maximum of 32MB of on-board memory.

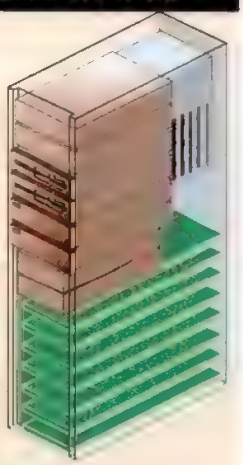
The Mylex board allows for expansion with eight 32-bit EISA slots. The top six support bus mastering (a technique that increases the system's efficiency by letting a card—for example, a disk controller—take control of the system momentarily). Burst mode allows large quantities of data to be sent across the bus during certain cycles. The last two slots on the motherboard are capable of handling 32-bit cards but do not provide bus mastering and burst mode.

The Zeos 486-25C came with a Diamond SpeedSTAR VGA with 1,024K of RAM dedicated to the video board. The SpeedSTAR is a 16-bit VGA card capable of displaying up to 1,024-by-768 resolution.

Zeos supports its machines admirably. The warranty includes a 30-day no-questions-asked money-back guarantee. The warranty is good for one year on parts and labor and five years on the keyboard. Phone service is toll-free, 24 hours a day, 365 days a year, and includes parts shipping if necessary.

If you use a network or if you are a high-end power user, this machine will definitely suit your needs. The Zeos 486-25C is filled with quality components that should speed you through your tasks. With its Mylex 32-bit SCSI caching controller and high-performance Diamond SpeedSTAR VGA, it performs remarkably well. This Zeos PC is highly recommended to anyone who needs power, performance, and service from a proven winner. ■

FACT FILE
EDITORS' CHOICE



Zeos 486-25C
Zeos International Ltd., 530 Fifth Ave. NW, St. Paul, MN 55112; 800-423-5891, 612-633-4591.
List price (tested configuration): $7,645.
Memory and processor RAM cache: 8MB 80-ns. SIMMs, 128K cache.
Disk drives and controller: Seagate 17-ms. 312MB SCSI, Mylex controller, 1MB cache; 1.2MB and 1.44MB floppy disk drives.
Display: Diamond 1,024 by 768 adapter with 1MB RAM, Zeos 14-inch monitor.
Software: DOS 4.01, *Windows* 3.0.

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386/33 Cache Base System

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- Norton SI (v. 4.5): 28.2 *(386/25 Non Cache)* 38.3*(386/33Cache)**
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- 2MB RAM *(expandable to 16MB)*
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- 14" VGA Monochrome Grey Scale Monitor
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- 1.2MB or 1.44MB Floppy Drives

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Standard Features

- True 25 or 33MHz 80386DX CPU Operating at Zero Wait States
- Direct Map Cache Processor with 64K Static RAM on 386/33 Cache System
- 1MB RAM expandable to 16MB on the System Board
- 1:1 Interleaved Hard/Floppy Drive Controller, with 1MB/second disk transfer rate
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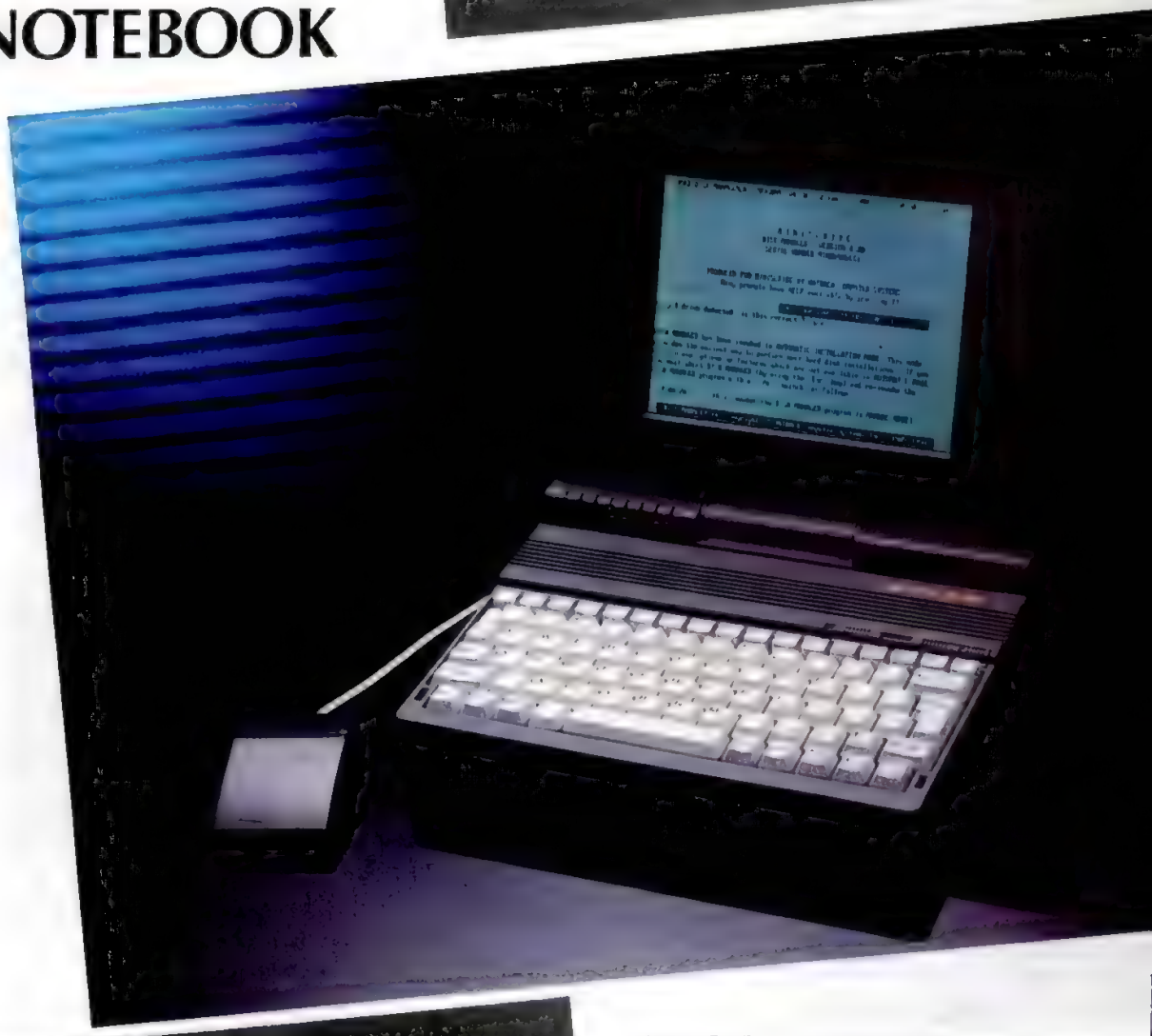

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CIRCLE 134 ON READER SERVICE CARD

Arc Tangent
Mailing List Management:

Small Steps to Big Postage Discounts

How much money does your business spend on mailings? Arc Tangent's mailing list management software can lead you to the best possible postage rates.

by Bruce Brown

If your organization sends out 10,000 pieces of first-class mail a month, you may be spending almost $35,000 a year on postage. If you use all the money-saving mailing tactics the United States Postal Service offers, you can do the same mailing for about $15,000. Whether you mail a few first-class letters a week, hundreds of invoices a month, newsletters to clients, or mass mailings to prospective customers, the cost of these mailings can't be ignored. And how do you give your mail to the post office the correct way for speedier service? Do you need a minicomputer and a special staff of mail handlers?

PHOTOGRAPHY: THOM O'CONNOR

GETTING THE MOST FOR YOUR POSTAGE DOLLAR

by Bruce Brown

Perhaps you didn't notice, but postal rates are up. As of February, new rates went into effect for all classes of mail. Nevertheless, the more you help the post office to handle your mail automatically, the better the deal is for you. If you understand and take advantage of the USPS rate structure you can cut costs significantly.

The best rates for bulk mailing involve various levels of presorting the pieces you mail. You can also get a two-cent decrease in the First class single piece rate if you use a return envelope provided by companies that have the addressee's ZIP code and carrier route printed in bar code.

First class mail discounts use the following hierarchy of presort levels to get progressively better discounts (note that in all cases other than regular mail you must be mailing in bulk and follow the USPS's precise piece count and packaging requirements):

- Regular mail
- ZIP+4 unsorted
five-digit presorted
- ZIP+4 presorted
- ZIP+4 bar-coded
- Carrier route presorted.

Third class mail, used by most business mailers for catalogs and direct marketing pieces, is for bundled, printed material and has six levels of presorting discounts (listed here in order of increasing discount):

- Basic bulk (sorted by five-digit ZIP code, minimum ten pieces)
- Basic ZIP+4 (minimum 200 pieces)
five-digit presorted (minimum 200 pieces)
- ZIP+4 presorted
- ZIP+4 bar-coded
- Carrier route presorted.

The money you can save by using *Professional Mail* and *Zip++* with the *National Database* can quickly add up, especially with the new postal rates. If you mail a lot of first-class mail pieces, ZIP+4 presorting can save you 4.8 cents per letter, and carrier route presorting can save 6 cents a letter, compared to the full 29-cent-per-piece rate.

While 4.8- and 6-cent savings don't seem like much for just a few pieces, the more you mail, the more money you save. But you don't have to be a huge mailing house that sends out plane loads of mail to make discounts worthwhile. If you mail 1,000 pieces a month and meet the USPS minimums and bundling requirements, your monthly mailing cost for first-class mail drops from $290 to $242 just by sorting ZIP+4 codes. The annual savings at 1,000 pieces per month is $576. If you mail 10,000 pieces a month, the annual savings is $5,760.

It used to be that way, but now Arc Tangent, a Santa Barbara-based company, has a family of high-powered PC products that can help you get the most from your postage budget. The two best ways to cut postage costs are by managing your mailing lists carefully and by taking advantage of the most favorable postage rates. Arc Tangent's products—*Professional Mail*, a $695 mailing list creation and management package, and *Zip++*, a $195 CD-ROM-based package that checks and corrects addresses with city, state, or national databases—do both.

There are, of course, many other mailing list managers available, including several from Group 1 Software (Greenbelt, MD; 800-368-5806) which bought the Arc Tangent technology in 1987 and continues to sell equivalent products under the names *ArcList* and *Accumail*. We focus here on Arc Tangent's products because their integration is excellent, their speed is impressive, and recent drastic price cuts have made them more attractive than ever.

THE WAY IT USED TO BE

Traditionally, huge mailing lists have been handled either through mailing list service bureaus or by in-house mainframes or minicomputers. These solutions are expensive, especially for small to medium–size companies, and when you use a service bureau, it's easy to feel that you're not in control of your own list.

Surveys of PC database users show that a large percentage use their own packages to maintain mailing lists. Low-end packages, while usually easy to set up and use, are typically only suitable for a few thousand names and don't have the flexibility that is needed for sophisticated list management. Heavy-duty database software will let you build any file-control structures that you want, but the time and cost of creating your own custom database or hiring a consultant to program one for you can be prohibitive.

> The time and cost of creating a custom database can be prohibitive.

There is a multitude of low-end PC mailing list software sold via retail channels and in the public domain as shareware. These packages are often good solutions for small mailings, but not appropriate if you have tens or hundreds of thousands of names on multiple lists that require intensive management and manipulation. The low-end programs usually include ZIP code sorting, but none offer the variety of sorting options you need to get the very best postage rates (for details on those discounts, see the sidebar "Getting the Most for Your Postage Dollar.")

Arc Tangent's products combine powerful database management with special mailing list functions and a huge file of valid U.S. address information. The software provides almost all you need to maximize your mail dollar: list creation (including the ability to import data from database programs), intelligent list management to standardize addresses and identify costly duplicate addresses, mailing-label processing features that cover every function from sorting and printing labels to printing mail bag and tray labels, built-in and editable postal rate informa-

POSTAL DISCOUNTS: THE SAVINGS ADD UP

Discount type	Rate	Savings per 100 pieces	Savings per 1,000 pieces	Savings per 10,000 pieces	Savings per 100,000 pieces
FIRST CLASS					
Regular unsorted	$0.2900	$0.00	$0.00	$0.00	$0.00
ZIP+4 presorted	$0.2420	$4.80	$48.00	$480.00	$4,800.00
ZIP+4 bar-coded	$0.2330	$5.70	$57.00	$570.00	$5,700.00
Carrier route presorted	$0.2300	$6.00	$60.00	$600.00	$6,000.00
THIRD CLASS					
Basic bulk (five-digit ZIP)	$0.1980	$9.20	$92.00	$920.00	$9,200.00
ZIP+4 presorted	$0.1971	$9.29	$92.90	$929.00	$9,290.00
ZIP+4 bar-coded	$0.1790	$11.10	$111.00	$1,110.00	$11,100.00
Carrier route presorted	$0.1310	$15.90	$159.00	$1,590.00	$15,900.00

If you add carrier route codes, the savings are even better. Instead of paying $290 to mail 1,000 pieces you pay only $230, saving $60 a month or $720 a year. At 10,000 pieces a month, the savings increases to $7,200.

Third-class postage extends your savings even further. By mailing regular bulk Third-class with five-digit ZIP-code sorting you save $92 a month and $1,104 a year if you mail 1,000 pieces a month. Third-class ZIP+4 sorting and bar code ZIP+4 sorting also save money, $1,114 and $1,332 a year, but the most significant leap with Third-class mail is when you use carrier route sorting.

Assuming that you meet the minimums for third-class bulk mail, you can save almost 16 cents per letter if you can do carrier route sorting. That means that mailing 1,000 pieces a month can save you $1,908 in one year compared to regular first-class postage rates.

Presorting requirements are precise and vary significantly between classes of mail, with differences in minimum numbers of pieces in a sort and in the bundling, bagging, or tray container requirements. There are also very specific container label and report requirements. For the exact information, you should obtain a copy of the *Mailer's Guide* from your local post office. Another valuable publication, the *Domestic Mail Manual*, is available from the Superintendent of Documents, Government Printing Office, Washington, DC 20402-0001. ■

tion, and the ability to print bar-code labels (for which the post office will reward you handsomely). All you need to add are the addresses.

HOW WE TESTED

To exercise *Professional Mail* and *Zip++*, we used the nine-year-old mailing list of a PC user group. The full mailing list consists of 22,775 names in a *dBASE III Plus* file—not huge, but of an adequate size to test the software. When we wanted to see how a feature worked on a smaller list, we used a 1,000-record subset.

We ran our tests on a 20-MHz 386 system with 4MB of RAM and a 135MB hard disk. The system also had a Chinon internal CD-ROM drive, a mandatory accessory for *Zip++*'s CD-ROM *National Database*.

The earliest version of *Professional Mail* was introduced as *ArcList* in 1986, and the versions tested here date from last October. Future product plans include *Microsoft Windows* versions due in mid-1991, Unix versions to run on Sun systems, and further development of modular programs for people who want to stick with databases like *dBASE* and *R:BASE* but want to add Arc Tangent's duplicate checking and purging, entry screen, or address correction and coding functions.

PROFESSIONAL MAIL

Professional Mail, Version 2.02, is a database-style package designed to handle mailing lists. You can use it alone to create, enter, edit, and manage lists, or you can import data from *dBASE II, III*, or *IV*, or in comma delimited or fixed-length ASCII formats.

Professional Mail keeps lists free of duplicate names and addresses, sorts for United States Postal Service (USPS) regulations for first-, second-, and third-class mail, and prints standard or custom label sizes and designs, including ZIP+4 bar codes. It can also print tray and sack labels and postal reports.

Professional Mail also includes a built-in word processor with form letter functions that, combined with the program's conditional record selection and programming features, can be used to customize mailings based on a multitude of record codes and conditions.

The program's documentation advises you to have at least 5.3MB of space available on your hard disk before installing *Professional Mail*. On our test system, the program used only 4.2MB. The package comes on five 720K 3.5-inch floppy disks and on three 1.2MB 5.25-inch floppy disks.

When you run *Professional Mail*, all functions are controlled from the Main Menu, which is a horizontal box just above the center of the screen. The Main Menu choices include Add, Edit, Manage, Labels, Documents, and Reports. When you make a menu selection, successive lower-level menu boxes appear on the screen. The program has on-line context-sensitive help, and you'll find the manuals helpful.

CREATING A LIST

The first step in working with a list in *Professional Mail* is to select a predefined list structure or create a new one. The program comes with four list formats, and creating a new list involves a simple screen-painting design process. Six fields are required in any list: First Name, Last Name, Street, City, State, and ZIP.

The only practical limitations on record and list size are the speed of your system and your hard disk size. Your file design can include up to 12 pages of 21 lines with multiple fields on each line.

Field types consist of numeric, text, and date fields. Various validation options include range checking for numeric and text fields, date format checking, mandatory fields, and ZIP and state code matching.

There are also special match code fields that let you assign special numeric values to individuals for later record selection or processing. For example, you can have a code field to indicate the source of a name, another to indicate customer activity levels, and further codes to designate demographic characteristics. These code fields can be used with record criteria selection to create highly focused mailing lists. Used well, these codes can turn your mailing list into a full-fledged marketing tool.

Professional Mail allows up to ten indexes per mailing list and has four default indexes: Record Number, ZIP Code-Carrier Route Code, Soundex (used for duplicate checking), and a compound index with the Last Name, First Name, Street, and ZIP Code fields.

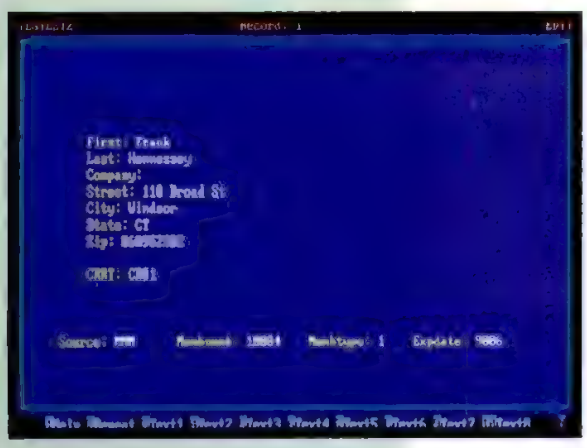
IMPORTING RECORDS

If you want to import records from an existing database as we did, you start by altering an existing *Professional Mail* list definition or creating a new one from scratch to match the field structure of the source database. It's not necessary to bring over all fields; at the beginning of the import process, you see a vertical list of the defined *Professional Mail* fields on the left side of your screen and field contents from the first record of the source file listed vertically on the right side of the screen. A simple field matching process lets you indicate the fields in the source database that *Professional Mail* should import from.

When you import records into *Professional Mail*, you use a simple "match" screen to coordinate incoming data with predetermined field names in the target *Professional Mail* file.

Import times are impressive. The 1,000-record test file took just 49 seconds to be imported. Of that time, approximately 13 seconds were needed to transfer the records and 36 seconds to build the four default indexes. The full 22,775-record file required only 44 minutes to import: 5 minutes to bring in the data and 39 minutes to index it. To speed up this process you can disable the default sound-alike index, last-first-street-ZIP code, and ZIP-carrier route indexes, but not the record number index. With only the record number index enabled, the 5-minute transfer time stayed the same, but building the single index added only 52 seconds to the import process for a total import time under 6 minutes.

When you import a file, you can specify case conversion, selecting mixed case or all upper case characters for text fields. Since the Computer Society database is in all capitals (a technique used to speed data entry), we chose mixed case conversion to see how it would do. Case conversion doesn't add much to the import time and works well with three exceptions: names with multiple capital letters like "MicroSources," acronyms (the FBI becomes the Fbi), and multiname organizations like Smith, Jones, and Black, in which you must leave a space after each comma to ensure that all the names will be capitalized. You can always edit individual records to correct cases, but with large lists that could take hours.



Professional Mail's edit screen uses the program's customizable entry screen, which can consist of up to 12 screens of 21 lines each.

SUPER DUPES

One of *Professional Mail*'s most impressive features, and one that can save mailers embarrassment and wasted money, is its duplicate record checking. Duplicate names result in multiple mailings to the same person, irritate the recipient and ruin the impression of personal service. In most instances, and especially with large lists, regular duplicate checking is perceived as too time-consuming.

Professional Mail lets you find and purge duplicates in several ways. The first and most obvious process is the exact match record. *Professional Mail* also lets you specify high, medium, or low levels of "near" duplicate matching, which searches for similarities in ZIP codes, street addresses, and names. Going beyond exact spellings for the text fields, the program uses the Soundex index to find similar, though not exact, records. The last type of duplicate checking is via the match code fields, where you can use fields such as customer number or product registration number to find redundant entries.

You can check for duplicates by comparing records within a single list or by comparing the active list with up to four other lists at once. With multilist checking, duplicates are not found among the secondary lists, but rather within the active list and between it and the other lists.

When you run the duplicate checking routine, you can choose among four resulting actions: Purge, Merge, Query, and Report. Purge erases duplicate records based on the location of each record in

active or secondary lists or based on a comparison of the values in a specified field. Another Purge option erases both records and writes their contents in a discard file. The Merge option brings information from secondary lists into the duplicate field found in the active list. Query presents duplicates on-screen so you can choose which one to keep or save. The last option is Report, which doesn't delete any records but instead prints a report of all duplicates that are found.

We ran the duplicate checking routine on the 1,000-record test mailing list, checking for exact matches and for each level of near matching. With each of the three methods, it took 5 seconds to check all the records. Set at Exact match, *Professional Mail* found four duplicates. With Near duplicate matching set, the program identified 27 records at a high level of matching, 36 records at the medium setting, and 33 records at the normal setting. We ran the routine in the Query mode, which presented the records in pairs on-screen so we could see the results. With the near-match levels set, many of the paired records were instances of businesses with the same or similar names located at the same address.

Professional Mail **has five levels of duplicate record checking, including exact match, high, medium, or low levels of near matching, and matching via codes in special fields in the file. At the completion of duplicate checking, the screen shows how many duplicates were found.**

USPS RULES FOR COST SAVINGS

List management, via Manage from the Main Menu, lets you choose an active list, create a new list from scratch or by copying an existing list, combine lists (including duplicate deletion), import and export lists, and run a special backup routine to make copies of lists on designated drives, including backups onto multiple floppy disks.

Label printing is one of *Professional Mail*'s strong functions, with 17 predefined label formats and a simple label-design screen. *Professional Mail* also has the ability to print bar code ZIP code labels, using dot matrix or laser printers. Bar codes for ZIP+4 ZIP codes help you get the very best postal rates because the Postal Service's scanning machines can sort bar coded pieces automatically.

During label printing you can select a sample mailing with a skip factor between 2 and 9,999. If, for example, you want to test a direct mail piece on a portion of your market and you have a 200,000-name mailing list, a skip factor of 200 would print a sample run of 1,000 labels to send for the market test. This is called "Nth" Sampling, with "N" referring to the number used as the skip factor: in other words, printing a label for every 200th record.

One of *Professional Mail*'s most valuable features is its ability to conform to USPS rules and regulations. You can print labels in any index order or sort them according to USPS rules for different mail classes. Since the presort rules for each class of mail differ and are all fairly complicated and precise, this feature alone is worth the program's price. You can save money by automatically sorting, and the package can lower your postage costs via ZIP code and carrier route sorting.

After labels have been printed, *Professional Mail* will print sack and tray labels and required reports appropriate for each class of mail. Keep in mind that you don't necessarily have to use labels. There are quite a few printers on the market designed exclusively for envelopes (see "Name and Address for Less: Envelope Printers Cut Your Costs," *PC Magazine*, January 29, 1991).

Professional Mail's Documents menu is where you create form letters. A text editor that works with look-up tables to determine document contents is included, and you can insert printer codes in the document for using specific fonts or print features. The package's criteria selection process lets you insert specific boilerplate text depending on the value or contents of specific fields. You can also use Nth sampling and presorting routines when printing documents.

> You can print labels in any index order or sort them according to USPS rules for different mail classes.

In addition to labels and documents, *Professional Mail* can also print reports based on the contents of lists. You can use these reports—in list, table, line, and chart formats—for internal information and analysis of list contents. Reports can consist of full listings of file contents, up to three levels of subhead reports organized by any field, or line query reports that group records by a specified field. You can also generate reports on total information based on the field contents, profile reports that perform calculations based on record contents for list analysis, and charts that show a vertical bar chart analyzing list distribution.

MACRO COMPILING

Professional Mail includes macro capabilities in two areas: recorded macros and control commands. The macro recorder works, as in many other programs, by creating a file of all keystrokes made while the macro recorder is on. The resulting macro file is an ASCII text file editable by any text editor. A special feature is macro compiling to first debug a macro script and then convert it into machine code so it will run faster and be protected from inadvertent editing. A compiled macro script has an .MXE file extension and can run via the Alt key in combination with a single letter macro script name.

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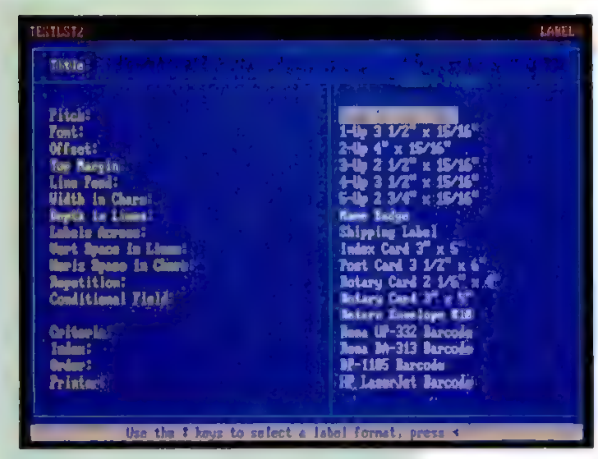
bargain considering all the capabilities you get. Toll-free customer support is provided for 90 days. You can then sign up for a $125 one-year service-and-support contract entitling you to support and program upgrades. Given the ever-changing nature of postal regulations, it's a good idea to buy the service contract.



Professional Mail **includes a variety of preset label printing formats. You can also create your own formats.**

Even without Arc Tangent's complementary program, *Zip++*, *Professional Mail* can save you time and money with its mailing list management capabilities and postal rule and sorting information that would otherwise be cost prohibitive.

ZIP++ AND NATIONAL DATABASE

Zip++, Version 1.08, and the *National Database* (on CD-ROM) are simpler, yet more impressive than *Professional Mail*. *Zip++* is a mailing address correction program. Correct addresses on mailing pieces can speed delivery, prevent costly returns, and present a better image to recipients who might wonder about the quality of a firm that sends mail with faulty addresses. Used in conjunction with the *National Database*, *Zip++* can add correct ZIP+4 postal codes and carrier route codes for every valid mailing address in the United States.

Though the version of *Zip++* we tested cost $795 and the *National Database* cost $695 per quarter or $1,895 for an annual subscription, Arc Tangent has drastically lowered the price of the currently shipping version 2.0 to $195, including the *National Database*. If you use ZIP+4 and carrier route coding (necessary to get the best postal rates), the USPS requires that the list be updated on a quarterly basis. The post office issues new carrier route data files effective each year on January 15, April 15, July 15, and October 15. Arc Tangent issues new CD-ROM disks for its *National Database* on the same schedule, and each set now costs $195.

PASSING THE POST OFFICE TEST

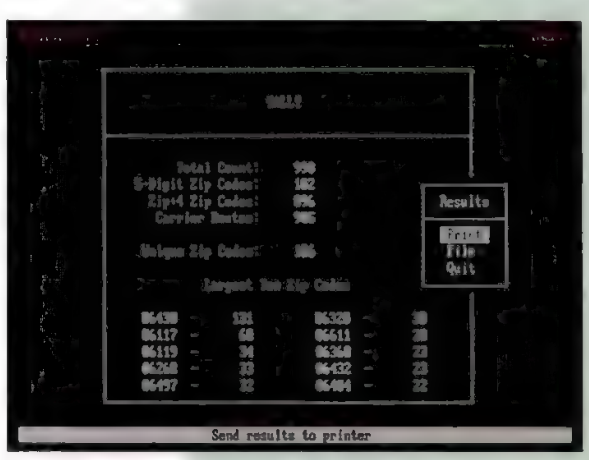
The post office runs random tests, and if five percent or more of a ZIP code's carrier route codes are incorrect, that mail is charged at the higher first-class sorted mail rate. That's why this application of CD-ROM technology is as impressive in its cost-effectiveness as it is in its execution. Every valid mailing address in the country is on one CD-ROM disk (along with many company names); the disk contains a compressed version of the USPS's 3.2GB address file.

The downside of working with CD-ROM disk drives is that access time is slow compared to that of hard disks. During processing, the screen indicates the number of records accessed and the number processed. When we started processing the full 22,775-record mailing list it soon became evident that completing the whole list would take about a full day. It turned out that the size of the list and cleanliness of the records (many of the inactive records in the test list hadn't been used for several years, and accordingly, made the list very "dirty") had a significant impact on the speed of processing.

We ran the benchmark tests with every possible checking and correction option turned on, which made the CD-ROM disk drive access light burn almost constantly. When we ran the full option set on 1,000 records, the list was completed in just under 72 minutes. After processing, 897 of the 1,000 records had ZIP+4 ZIP codes, and 906 had been assigned carrier route codes.

The more work *Zip++* does, the better your list gets, so it's worth the time. If you have a large list, you'll need to allow enough time, perhaps dedicating the computer to the task for a full weekend. One way to work around the slow processing is to split your list into separate pieces for *Zip++* processing and later combine them in *Professional Mail* or in your original database program. Arc Tangent claims the new version of *Zip++* is three times faster than the version we tested.

Zip++ works directly with *Professional Mail* files but can also take *dBASE*, ASCII, and fixed-length record files. When you process files with *Zip++*, your file must have a nine-character field for the ZIP code and a four-character field for the carrier route code. You should also use a two-character Slush Code field in which *Zip++* will insert two-digit codes for any record it can't match in its database. The Slush Code reference in the manual lists the codes, which typically indicate invalid ZIP codes, improper or nonexistent street addresses, or other obstacles to finding a proper match. You can also instruct *Zip++* to standardize the spelling of address line words such as Lane, Boulevard, and Turnpike.



***Zip++*'s Tally function displays the total number of records, numbers of 5-digit ZIP codes, ZIP+4 codes, carrier route codes, unique codes, and the ten most common ZIP codes in your mailing list.**

The program's Tally feature performs a very quick count (under 5.5 minutes for the 22,775-name file, 13 seconds for the 1,000-record subset) of all ZIP codes and reports on the screen, the total number of records, 5-digit ZIP codes, ZIP+4 codes,

and carrier route codes in the current list. The Tally screen also displays the number of unique ZIP codes and the number of records in each of the ten most common ZIP codes. You can save to disk or print the results of the Tally process, listing every ZIP code and the number of records in each code.

Like *Professional Mail*, *Zip++* includes 90 days of free support and offers an annual support contract for $125, including program updates. For an annual charge of $175, you can buy a service contract for both.

FACT FILE

***Arc Tangent Professional Mail*, Version 2.02**
***Arc Tangent Zip++*, Version 1.08**
Arc Tangent National Database
Arc Tangent Inc., 121 Gray Ave., Santa Barbara, CA 93101; 805-965-7277.
List Price: *Professional Mail*, $695; *Zip++* and *National Database* on CD-ROM disk, $195 per quarterly edition.
Requires: *Professional Mail*, 480K RAM, DOS 3.0 or later. *Zip++*, 480K RAM, DOS 3.0 or later. *National Database*, High Sierra format CD-ROM drive.
In Short: *Professional Mail* is the best mailing list manager available today. The program combines list management, full sorting capabilities, custom label printing (including bar codes), form letters, and macro programming. You can add *Zip++* to get a powerful address correction and postal coding program, and use the CD-ROM-based *National Database* to access every valid mailing address in the United States, including ZIP+4 ZIP codes and post office carrier route codes. If you mail in bulk, *Zip++* can help you cut costs significantly.

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Arc Tangent's *Professional Mail*, in conjunction with *Zip++* and the *National Database*, can bring a high level of mailing list management and cost-saving techniques to any manager's desktop. The bottom line is that you may be able to mail more pieces with the same postage budget or save big money by using the most cost-effective mail addressing and bundling techniques. ■

Bruce Brown is a contributing editor of PC Magazine.

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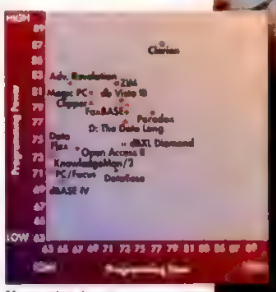

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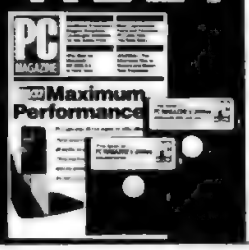

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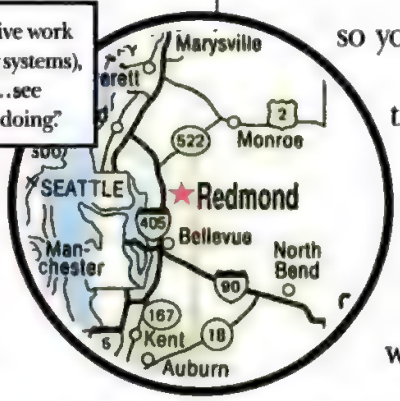

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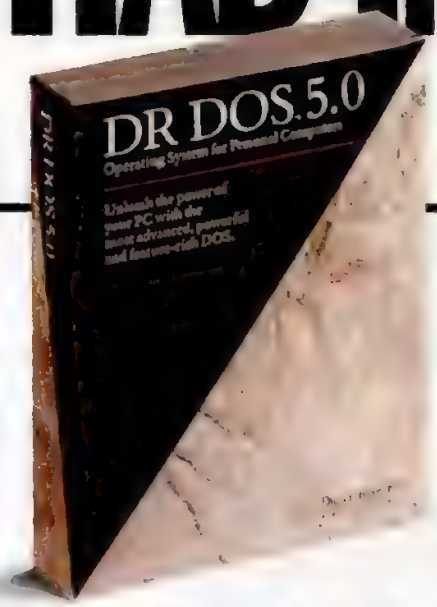

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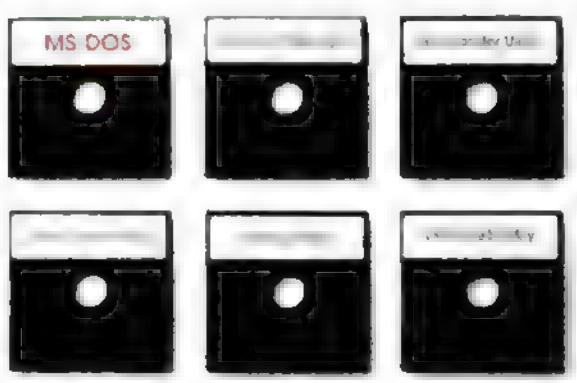

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by
Andrew Schulman

Lab Notes

The Programming Challenge of Windows Protected Mode

In last issue's Lab Notes, I explored and explained some of the benefits provided by *Windows*' use of the protected mode of the Intel 80286, 80386, and 80486 microprocessors ("Windows 3.0: All That Memory, All Those Modes"). Protected mode provides access to megabytes of memory, multitasking, and improved support for DOS applications. It also greatly simplifies memory management for *Windows* programmers. Indeed, from a programming viewpoint, *Windows* 3.0 is a protected-mode DOS extender.

Given Microsoft's market position and the rapid acceptance of *Windows* 3.0, protected-mode DOS must be considered the dominant operating environment for the next few years.

However, protected mode also has its downside. The Intel protection mechanism prevents program bugs from corrupting the system, but it also means that your programs can't just peek, poke, or call any old memory addresses they want. Accessing code and data outside your program becomes "impossible."

But if the vast majority of *Windows* programs are henceforth to be designed to run in protected mode, how then will they talk to device drivers, TSRs, and other precious resources that reside down in the first megabyte of memory, in real mode? In a nutshell, we must somehow accomplish the "impossible."

This issue's Lab Notes will examine the programming challenges software developers face as they try to move DOS programs to protected-mode *Windows*. You'll see why the keys to the solution lie in the new DOS Protected Mode Interface (DPMI) and in a number of undocumented features of the *Windows* application program interface (API).

In *PC Magazine*'s February 12, 26, and March 12, 1991, Power Programming columns, Ray Duncan showed how non-*Windows* DOS applications running under *Windows* can use DPMI. It is important to note that for these DOS programs, DPMI is (at least at present) available only in 386 Enhanced mode. For *Windows* programs, however, DPMI is available in both Standard and Enhanced modes. In this article we'll see how and when a *Windows* application can access DPMI.

> ■ Learning to use DPMI and a number of undocumented *Windows* services is the key to accessing real-mode memory from protected-mode *Windows* programs.

THE PROBLEM WITH PROTECTION

Because it offers programs a potentially enormous address space and because it supports multitasking, protected mode must establish some "rules of the road" that were not necessary in the little 640K sandbox of real-mode DOS. These rules are the software equivalents of "keep your hands to yourself," "don't snoop," and "don't chew with your mouth open." That is, your programs can't peek (read), poke (write), or call (execute) memory that isn't mapped into their own address space. Furthermore, they can't execute data and they can't overwrite code. Protected-mode programs can allocate megabytes of memory, but they can't access memory that isn't theirs.

But many programs on the PC *need* low-level access to code and data that isn't theirs. Key system variables, for example, are kept in the BIOS data segment at memory location 400h (which can be represented by many real-mode addresses, including 0000:0400 and 0040:0000). Needless to say, this address is not located inside your program.

You can, of course, *try* to read this area from your protected-mode *Windows* program, using something like the following C code:

```
unsigned long far *pticks =
  (unsigned long far *) 0x46C;
unsigned long ticks = *pticks;
```

This code works in real mode, but in protected mode the variable `ticks` does *not* end up receiving the BIOS timer-tick count. What you get instead is the following message from *Windows*:

```
UNRECOVERABLE APPLICATION ERROR
Terminating current application.
```

Not so good.

If you run this short program within a debugger (CodeView for *Windows* (CVW) or Turbo Debugger for *Windows* (TDW)), your application will not be terminated. Instead, the debugger will display a message such as "Trap 13 (0DH) - General Protection Fault." If there were some way to repair the problem while still in the debugger, you'd be able to resume the program. Usually that isn't possible, so there's no way to continue past the line of code that violated protection. But at least the debugger shows you where the problem is.

For a software developer, CVW's "General Protection Fault" is a much more informative message than *Windows*' "Unrecoverable Application Error"

(UAE). A general protection fault (GP fault) is generated by the Intel processor whenever the rules of protected mode have been violated. An operating environment installs a handler for this INT 0Dh exception. In *Windows*' case, the handler responds by shutting down the offending application and displaying the rather uninformative UAE message box.

Up to this point, we have seen that whenever a DOS program that has been moved to protected mode tries to access an external real-mode memory location such as 0040:0000, it generates a GP fault. So when you move to protected-mode *Windows*, how *do* you continue to access the resources you used in real mode? Besides the BIOS data area, for example, how would you communicate with a database package, TSR, or a network driver? How could you access the undocumented DOS data structures that *PC Magazine* utilities frequently use? Is there no way to take these with you when you cross the border into protected mode?

This is vitally important, for it will be many years before every driver, TSR, and memory-mapped device is made directly accessible in protected mode. Until then, developers *must* be able to access real-mode services and absolute memory locations from their protected-mode programs. Fortunately, as we'll see, the low-level aspects of the machine *are* still visible from protected mode. And programmers who can write protected-mode code that talks to real mode will find that they have an increasingly marketable skill.

REAL-MODE DEV CODE — **COMPLETE LISTING**

```
ListOfLists far *doslist;
DeviceDriver far *dd;
// ...
dd = &doslist->nul;
for (;;)
{
    printf("%Fp\t", dd);
    if (dd->attr & CHAR_DEV)
        printf("%.8Fs\n", dd->u.name);
    else
        printf("Block dev: %u unit(s)\n", dd->u.blk_cnt);
    dd = dd->next;
    if (FP_OFF(dd->next) == -1)
        break;
}
```

Figure 2: The C code for walking the DOS device list in real mode.

WALKING THE DEVICE CHAIN

Consider a common DOS program that simply displays the names and addresses of all device drivers loaded on your system. Both Turbo C++ and Borland C++ come with such a program—called TDDEV—and Quarterdeck Office Systems' *Manifest* includes a similar display.

A DOS program like TDDEV can, of course, be run under *Windows*. But how would you turn this into an actual *Windows* program, so that it can interact with the user instead of simply dumping information out to the screen? Eventually, you might want to make it possible for the user to click on a device name to obtain more-detailed information. All sorts of possibilities open up once it's a genuine *Windows* program. But for now let's be content with the same, noninteractive output, changing the program only so that it runs on the *Windows* side of the fence rather than in a DOS box. The output of such a *Windows* DEV program is shown in Figure 1.

One issue to be faced in contemplating the necessary changes is how to structure the *Windows* source code so that it continues to resemble, as closely as possible, our old character-based DOS code. For example, it would be nice to continue using the C printf() function and to avoid (at least for the time being) the complexities of *Windows* event-driven programming. (This issue is later explored in the sidebar "Windows and printf().")

In *Windows* 3.0, the program will need to run in the Standard and 386 Enhanced modes of *Windows*. That, in turn, means running in the protected mode of the Intel 80286, 80386, or 80486. A DEV program must walk the DOS "device chain," printing out the name and address of each driver found on this linked list. The challenge in porting such a program to protected-mode *Windows* is that the DOS device chain is a real-mode data structure, located in conventional memory. We must somehow access this data structure from protected-mode *Windows*. We have already seen that attempting such access normally produces a UAE or GP fault.

It's easy to produce this information in a real-mode DOS program. First, you make the undocumented DOS call INT 21h function 52h to get a segment:offset far pointer to the DOS internal variables table (sometimes called the List of Lists). The header for the NUL device is stored right inside this table, and the NUL device is the anchor for the entire DOS device chain. It is called a *chain* because each device header contains the address of the *next* device; it is a linked list.

In Figure 1, NUL is at the real-mode address 0000:1228. It contains a pointer to the next device, which in this example is *SmartDrive* (SMARTAAR). The pointer is simply a 4-byte number, 0000:8B80, the address for SMARTAAR. SMART-

Figure 1: DEV.EXE, a protected-mode *Windows* program, produces an output similar to a normal real-mode DOS program.

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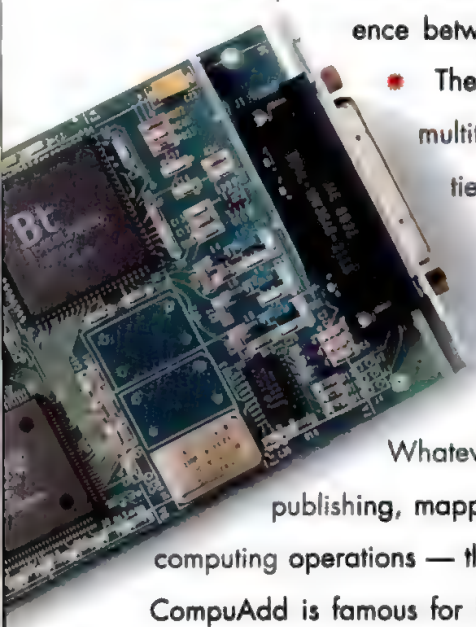

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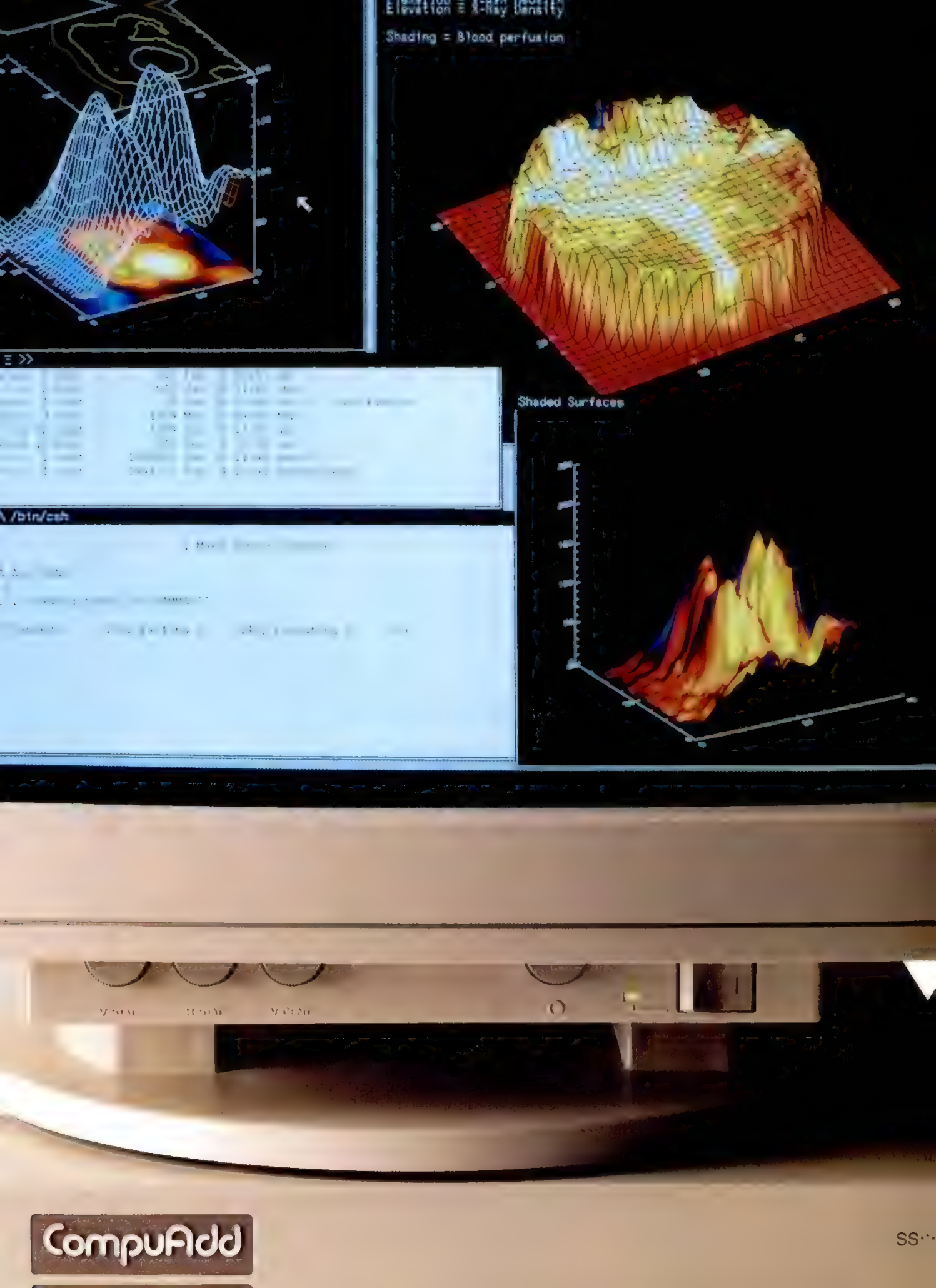
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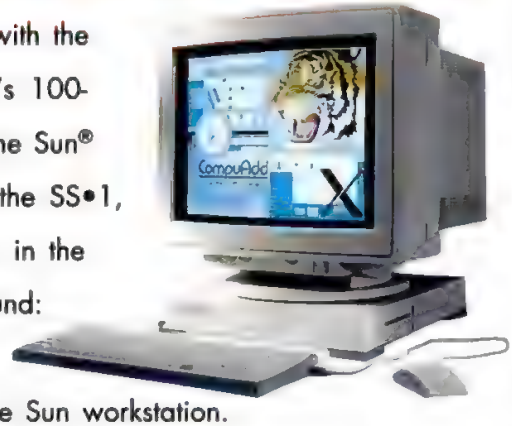

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AAR's device header in turn contains a pointer, 0D34:0000, to the Microsoft Mouse (MS$MOUSE). The list continues in this fashion until it gets to a Lotus/Intel/-Microsoft Expanded Memory Manager (EMMXXXX0), whose device header lives at real-mode address 199F:0000 and which, incidentally, has been patched into the DOS device chain by *Windows* in Enhanced mode. Here the "next" field contains a -1 (FFFFh) in its offset portion. You know you've reached the end of the list when you find a "next" field whose offset is FFFF.

As the program walks this list, it prints out the driver's address, and either the name (for character devices) or the number of units the device provides (for block devices). For both cases, this information is found in the device header. In a C program written for real-mode DOS, a loop that walks the device chain would look something like the code shown in Figure 2.

There is a direct correspondence between this code and the output shown in Figure 1. But that display comes from a protected-mode *Windows* program. How did the program access these real-mode addresses from protected mode? Why didn't it terminate with a UAE or a GP fault?

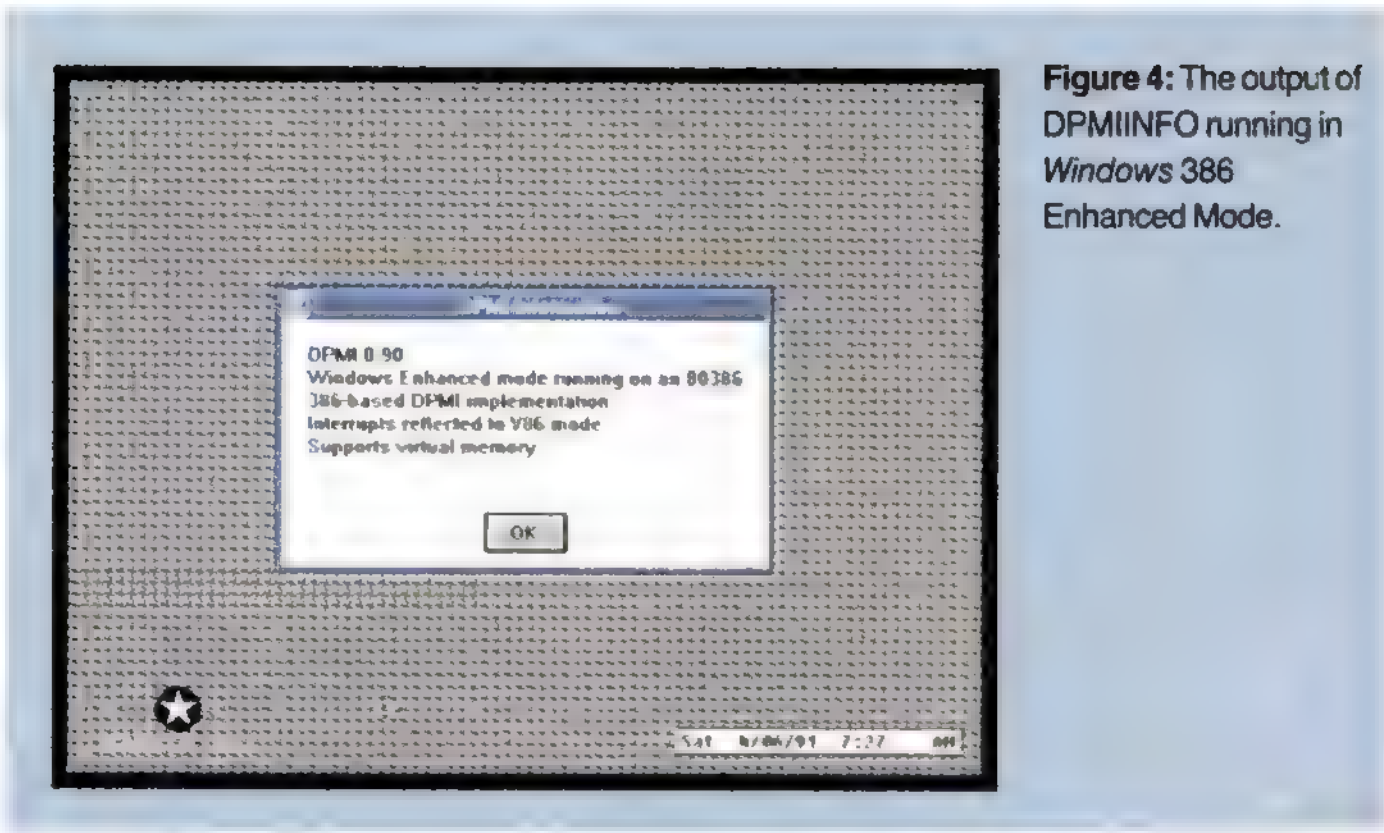

Figure 4: The output of DPMIINFO running in *Windows* 386 Enhanced Mode.

ENTER DPMI

As I mentioned earlier, by utilizing the DOS Protected Mode Interface (DPMI) and some undocumented *Windows* services, protected-mode *Windows* programs *can* do all the low-level things they need to do, without breaking the rules of protected mode. In protected mode, DPMI uses interrupt 31h to provide a set of services for calling real-mode code, mapping real-mode memory locations into the protected-mode address space, hooking real-mode interrupts, and the like.

Unlike the EMS and XMS specifications, DPMI was never designed for widespread use. It was intended for system software, not application programs. The DPMI specification was drawn up by a committee that included Microsoft, Intel, Lotus, Phar Lap, Quarterdeck, Rational Systems, IBM, Borland, and other companies, and the assumption was that this handful of companies would constitute DPMI's user base.

The true purpose of DPMI is to allow the peaceful coexistence of protected-mode DOS extenders, expanded memory managers, and DOS-based multitasking environments. As with the earlier VCPI (Virtual Control Program Interface) specification developed by Quarterdeck and Phar Lap, users—and the vast majority of programmers—are expected to care only whether the products they use support the specification. As for the details of the specification itself, they couldn't care less.

That was the theory. What happened, however, is that *Windows* programmers discovered a major gap in the *Windows* application programmer's interface (API). Among all the 500-plus functions listed in the massive *Windows Programmer's Reference* there is nothing that lets you call a DOS device driver, for example. You can't even find its location in memory.

DPMI, on the other hand, *does* provide services that allow low-level access to the machine from protected mode. And DPMI is incorporated in *Windows*. Consequently, many programmers look to DPMI (and to a number of useful, but undocumented *Windows* functions and features) as the back door to *Windows* 3.0 (to coin a mixed metaphor).

Figure 3: The output of DPMIINFO running in *Windows* Standard Mode.

CALLING DPMI

Before jumping in and applying DPMI directly to our DEV program, let's sample a more easily digested example of DPMI in a *Windows* program. DPMIINFO is a small utility that simply displays a few interesting facts about whatever DPMI implementation is present. The screenshots of DPMIINFO shown in Figures 3 and 4 summarize some of the crucial differences between *Windows* Standard and 386 Enhanced modes. While these were discussed in last issue's Lab Notes, they're worth reviewing here.

Whereas 386 Enhanced mode supports virtual memory (paging to disk) and is 386-based (that is, it supports 32-bit pro-

tected-mode DOS and *Windows* programs), Standard mode is 286-based (it supports only 16-bit programs) and does not provide virtual memory. Furthermore, in 386 Enhanced mode, interrupts generated in protected mode (such as interrupt 21h) are "reflected" (passed on) to DOS running in Virtual 86 (V86) mode, while in Standard mode, DOS is running in plain-old real mode.

The lines "Windows Standard mode running on an 80386" and "286-based DPMI implementation" in Figure 3 also remind you that the 286-based 16-bit-only Standard mode can just as easily run on an 80386 processor as on an actual 80286.

Finally, Figures 3 and 4 also indicate that *Windows* 3.0 uses DPMI, Version 0.9. While the specifications for DPMI 1.0 have been drawn up, it's DPMI 0.9 that most end users will have on their machines for some time to come. (The DPMI 0.9 specification is available free of charge from Intel. Call 1-800-548-4725 and ask for Part No. 240763.)

Turning to the DPMIINFO.C source code, which is shown in Figure 5, we see that there are several tests that should be made before you call the DPMI INT 31h functions.

First, you should see whether you are running in protected mode. We use the *Windows* API GetWinFlags() function for this.

Next, you check whether DPMI is present, using the DPMI Mode Detection call, INT 2Fh AX=1686h. (Note that this is *not* the INT 2Fh AX=1687h call, which is used to obtain the real-to-protected mode switch entry point, and which was discussed in last issue's Lab Notes and in Ray Duncan's columns on DPMI. The 2F/1687 call is to be made by a real-mode program that wants to use DPMI to switch into protected mode; a program calls 2F/1686 to see whether it is *already* running in protected mode under DPMI.)

Windows applications are loaded in protected mode automatically, so they don't need the 2F/1686 call. This is fortunate, as this call is not currently supported in *Windows* Standard mode. That is precisely why DOS programs running in Standard mode can't access DPMI but *Windows* programs can.

Once you have determined that you are running in protected mode under DPMI, you can make interrupt 31h calls: INT 31h services are provided in protected mode only. In Figure 5, then, we call the DPMI Get Version function (INT 31h AX=0400h). The functions dpmi_present() and dpmi_version() called by DPMIINFO.C in Figure 5 are both provided (along with many other DPMI-related functions) by DPMI.H and DPMI.C, whose code listings are shown in Figures 6 and 7 respectively.

Note that DPMI.C (in Figure 7) uses in-line assembly language to make INT 2Fh and INT 31h calls. Microsoft C 6.0 and Borland C++ 2.0 both provide an in-line assembler, and DPMI.C will work with either compiler. We avoid the C int86() and int86x() functions here, because many implementations of these functions cause GP faults in protected mode—which is precisely what we're trying to avoid by going to DPMI!

In addition to the functions in DPMI.C and DPMI.H, you may want to look into one of several DPMI libraries now being sold. For example, SoftWorks International (404-876-6115) sells a library called *SoftDPMI*.

CALLING REAL-MODE SERVICES

We are now in a position to see how DPMI helps move the DEV program to *Windows*. In DEV.C (Figure 8), several blocks of code have been marked

```
#ifdef WINDOWS
```

This code is used when you build a program with -DWINDOWS on the compiler command line.

The first such block appears in the function get_doslist(). This is the function that, as noted earlier, calls the undocumented DOS function INT 21h AH=52h and returns a far pointer to the DOS internal variables table.

When it is being compiled for *Windows*, get_doslist() calls the function dpmi_rmode_intr(), which is declared in DPMI.H (Figure 6) and implemented in DPMI.C (Figure 7). The dpmi_rmode_intr() function simply provides a C interface to the DPMI Simulate Real Mode In-

DPMIINFO.C — COMPLETE LISTING

```
/*
DPMIINFO.C -- display DPMI information under Windows

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    PC Magazine * Andrew Schulman

Borland C++ 2.0:
    bcc -W -2 dpmiinfo.c printf.c dpmi.c
    rc dpmiinfo.exe

Microsoft C 6.0:
    cl -c -AS -G2sw -Oais -Spe dpmiinfo.c printf.c dpmi.c
    link /align:16 dpmiinfo printf dpmi,dpmiinfo,,/nod slibcew libw,wi|n.def
    rc dpmiinfo.exe
*/

#include <stdlib.h>
#include <stdarg.h>
#include <string.h>
#include <dos.h>
#include <windows.h>
#include "printf.h"
#include "dpmi.h"

#define FAIL(s) MessageBox(NULL, s, "DPMI Information", MB_OK)

int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
    LPSTR lpszCmdLine, int nCmdShow)
{
    unsigned long win_flags;
    unsigned flags;
    unsigned maj, min;
    unsigned proc;

    if (! ((win_flags = GetWinFlags()) & WF_PMODE))
        return FAIL("This program requires Windows "
                    "Standard or Enhanced mode");

    if (! dpmi_present())
        return FAIL("DPMI not present");

    dpmi_version(&maj, &min, &flags, &proc);

    open_display("DPMI Information");

    if (win_flags & WF_STANDARD)
        printf("DPMI %x.%x\n", maj, min); // silly bug in Standard mode
    else
        printf("DPMI %d.%d\n", maj, min);

    printf("Windows %s mode running on an %%%d%d6\n",
        (win_flags & WF_ENHANCED) ? "Enhanced" :
        (win_flags & WF_STANDARD) ? "Standard" : "Not Another?!",
        proc); // processor: 2=286, 3=386, 4=486
    printf("%d-based DPMI implementation\n",
        (flags & 1) ? 386 : 286);
    printf("Interrupts reflected to %s mode\n",
        (flags & 2) ? "real" : "V86");
    printf("%s virtual memory\n",
        (flags & 4) ? "Supports" : "No");

    show_display();
    return 0;
}
```

Figure 5: The DPMIINFO program displays the DPMI information shown in Figures 3 and 4.

DPMI.H COMPLETE LISTING

```
/* DPMI.H */

#pragma pack(1)

typedef struct {
    unsigned long edi, esi, ebp, reserved, ebx, edx, ecx, eax;
    unsigned flags, es, ds, fs, gs, ip, cs, sp, ss;
    } RMODE_CALL;

/* structure of a protected-mode descriptor */
typedef struct {
    unsigned limit, addr_lo;
    unsigned char addr_hi, access, reserved, addr_xhi;
    } DESCRIPTOR;

/* low-level DPMI functions */
BOOL dpmi_present(void);
void dpmi_version(unsigned *pmaj, unsigned *pmin,
    unsigned *pflags, unsigned *pproc);
BOOL dpmi_rmode_intr(unsigned intno, unsigned flags,
    unsigned copywords, RMODE_CALL far *rmode_call);
unsigned dpmi_sel(void);
BOOL dpmi_set_descriptor(unsigned pmodesel, DESCRIPTOR far *d);
BOOL dpmi_get_descriptor(unsigned pmodesel, DESCRIPTOR far *d);
BOOL dpmi_sel_free(unsigned pmodesel);

/* higher layer on top of DPMI */
unsigned DosAllocRealSeg(DWORD bytes, unsigned *ppara, unsigned *psel);
unsigned DosFreeRealSeg(unsigned sel);
unsigned DosMapRealSeg(unsigned rmpara, DWORD size, unsigned far *psel);
unsigned DosFreeSeg(unsigned sel);
void far *DosProtToReal(void far *prot);

void far *map_real(void far *rptr, unsigned long size);
void free_mapped_seg(void far *fp);
unsigned get_mapped(void);
unsigned verw(unsigned sel);

/* undocumented Windows functions */
extern DWORD FAR PASCAL GetSelectorBase(unsigned sel);
extern DWORD FAR PASCAL GetSelectorLimit(unsigned sel);
extern void FAR PASCAL SetSelectorBase(unsigned sel, DWORD base);
extern void FAR PASCAL SetSelectorLimit(unsigned sel, DWORD limit);
```

Figure 6: This is the DPMI header file.

terrupt function, INT 31h AX=0300h—one of the most important "translation services" provided by DPMI.

Wait a minute, though. Simulate Real Mode Interrupt? Translation service? Why can't we call INT 21h AH=52h via the C intdosx() function?

The problem is this: The *Windows* version of DEV.C is running in protected mode. INT 21h AH=52h is an MS-DOS function that runs in real mode. Since *Windows* is a DOS extender, one of its primary responsibilities is to provide INT 21h functions in protected mode so that *Windows* apps can open files, allocate memory, change subdirectories, and so on, simply by making INT 21h calls. But INT 21h AH=52h is a special case. Since it's an undocumented function, you have no idea whether or not *Windows* provides direct access to it in protected mode.

That's why you must invoke this function via the DPMI Simulate Real Mode Interrupt function. As can be seen in the get_doslist() function in Figure 8, a program loads up an image of the 32-bit CPU registers in an RMODE_CALL structure and then calls dpmi_rmode_intr(). Using dpmi_rmode_intr() is much like using the int86() function in Microsoft C and other compilers.

The point of this exercise is not simply to show how you make undocumented DOS calls from a *Windows* application. For all we know, INT 21h AH=52h may *be* supported in protected-mode *Windows*. Furthermore, a DOS extender can provide direct access to the undocumented DOS functions from protected mode. For example, Version 3.0 of Phar Lap's 386 DOS-Extender provides this and many other undocumented DOS functions in protected mode, so it eliminates the need for a Simulate Real Mode Interrupt function.

However, there will always be *some* functions to which a DOS extender does not provide direct access. The INT 21h AH=52h example is representative of that larger problem. If there is an interrupt-based service that you need to call and it is not supported directly in protected-mode *Windows*, then you must use INT 31h AX=0300h, probably via a C interface like dpmi_rmode_intr() as indicated above. DPMI also provides similar functions for calling stack-based real-mode procedures.

ACCESSING REAL-MODE MEMORY

The get_doslist() function returns a far pointer to the DOS ListOfLists structure. But *what kind* of far pointer? When writing protected-mode programs for a fundamentally real-mode operating system like DOS, you must accustom yourself to asking, "Is this a real-mode pointer or a protected-mode pointer?" In the case of get_doslist(), INT 21h AH=52h returns a real-mode pointer in ES:BX even if you invoke it via the dpmi_rmode_intr() function.

You now have a real-mode pointer, and you want to examine the corresponding block of memory in protected mode. Thus, the next important #ifdef WINDOWS block in DEV.C calls the map_real() function. This function's job is to take a block of memory (whose size and real-mode address are passed as parameters) and return an equivalent protected-mode pointer.

Any time you have a *Windows* program that needs to peek or poke a piece of real-mode memory, you can use the map_real() function in DPMI.H and DPMI.C (along with its complement, the free_mapped_seg() function) without knowing anything about the underlying complexities of DPMI. Here, however, you may be interested in how map_real() works.

INSIDE MAP_REAL()

In DPMI.C, map_real() is built on top of the DosMapRealSeg() function, which in turn is built on top of several low-level C interfaces to DPMI functions.

The reason for all these layers is that the DPMI specification is extremely low level. Recall that the intent of DPMI was to provide services for a handful of DOS extender vendors to assure compatibility among their protected-mode extensions to MS-DOS. DPMI's developers had no idea that large numbers of *Windows* programmers would need to call DPMI services directly. Thus, it is best to construct several higher-level layers on top of DPMI.

The actual DPMI functions (with their

DPMI.C 1 of 2

```c
/*
DPMI.C -- DPMI functions, plus some undocumented Windows functions that
provide the same functionality, plus several layers of "sugar coating"
on top of these low-level services, to make them palatable

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    PC Magazine * Andrew Schulman
*/

#include <windows.h>
#include <dos.h>
#include "dpmi.h"

#define MAKEP(seg, ofs) ((void far *) MAKELONG((ofs), (seg)))

BOOL dpmi_present(void)
{
    _asm mov ax, 1686h
    _asm int 2fh
    _asm not ax
}

void dpmi_version(unsigned *pmaj, unsigned *pmin,
    unsigned *pflags, unsigned *pproc)
{
    unsigned char maj, min, proc;
    unsigned flags;
    _asm {
        mov ax, 0400h
        int 31h
        mov maj, ah
        mov min, al
        mov flags, bx
        mov proc, cl
        }
    *pmaj = maj;
    *pmin = min;
    *pflags = flags;
    *pproc = proc;
}

/* Performs a real-mode interrupt from protected mode */
BOOL dpmi_rmode_intr(unsigned intno, unsigned flags,
    unsigned copywords, RMODE_CALL far *rmode_call)
{
    if (flags) intno |= 0x100;
    _asm {
        push di
        mov ax, 0300h        // simulate real-mode interrupt
        mov bx, word ptr intno        // interrupt number, flags
        mov cx, word ptr copywords  // words to copy from pmode to rmode stack
        les di, dword ptr rmode_call  // ES:DI = addr of rmode call struct
        int 31h              // call DPMI
        jc error
        mov ax, 1            // return TRUE
        jmp short done
        }
error:
        _asm xor ax, ax      // return FALSE
done:
        _asm pop di
}

/* Allocates a single protected-mode LDT selector */
unsigned dpmi_sel(void)
{
    _asm {
        xor ax, ax           // Allocate LDT Descriptors
        mov cx, 1            // allocate just one
        int 31h              // call DPMI
        jc error
        jmp short done       // AX holds new LDT selector
        }
error:
        _asm xor ax, ax      // failed
done:;
}

BOOL dpmi_set_descriptor(unsigned pmodesel, DESCRIPTOR far *d)
{
    _asm {
        push di
        mov ax, 000ch        // Set Descriptor
        mov bx, word ptr pmodesel     // protected mode selector
        les di, dword ptr d // descriptor
        int 31h              // call DPMI
        jc error
        mov ax, 1            // return TRUE
        jmp short done
        }
error:
        _asm xor ax, ax      // return FALSE
done:
        _asm pop di
}

BOOL dpmi_get_descriptor(unsigned pmodesel, DESCRIPTOR far *d)
{
    _asm {
        push di
        mov ax, 000bh        // Get Descriptor
        mov bx, word ptr pmodesel     // protected mode selector
        les di, dword ptr d // descriptor
        int 31h              // call DPMI
        jc error
        mov ax, 1            // return TRUE
        jmp short done
        }
error:
        _asm xor ax, ax      // return FALSE
done:
        _asm pop di
}

BOOL dpmi_sel_free(unsigned pmodesel)
{
    _asm {
        mov ax, 0001h        // Free LDT Descriptor
        mov bx, word ptr pmodesel     // selector to free
        int 31h              // call DPMI
        jc error
        mov ax, 1            // return TRUE
        jmp short done
        }
error:
        _asm xor ax, ax      // return FALSE
done:;
}

/* Layer on top of DPMI and Windows services ****************************/

unsigned DosAllocRealSeg(DWORD bytes, unsigned *ppara, unsigned *psel)
{
    DWORD dw = GlobalDosAlloc(bytes);
    if (dw == NULL)
        return 8;   /* insufficient memory */
    *ppara = HIWORD(dw);
    *psel = LOWORD(dw);
    return 0;
}

unsigned DosFreeRealSeg(unsigned sel)
{
    return (GlobalDosFree(sel) != NULL);
}

/*
    Use DPMI services to map a real-mode paragraph into protected-mode
    address space. First we get a selector using the DPMI "Allocate
    LDT Descriptors" call (INT 31h Function 0000h), via our dpmi_sel()
    function. We then get the descriptor for any old data segment in
    our program so that it can be used as a template of sorts for the
    new descriptor. This is done with the DPMI "Get Descriptor" call
    (INT 31h Function 000Bh), via our dpmi_get_descriptor() function.
    We then alter the descriptor to reflect the "rmpara" and "size"
    requested, and finally associate the descriptor with our LDT
    selector, using the DPMI "Set Descriptor" call (INT 31h Function
    000Ch). All the user needs, of course, is the selector itself.
*/
unsigned DosMapRealSeg(unsigned rmpara, DWORD size, unsigned far *psel)
{
    DESCRIPTOR d;
    unsigned long addr;
    unsigned sel = dpmi_sel();
    if (! sel)
        return 8;   /* insufficient memory */
    /* make sure psel is valid */
    if (! verw(FP_SEG(psel)))
        return 498; /* invalid selector error */
    /* get descriptor for any data segment */
    dpmi_get_descriptor(FP_SEG(psel), &d);
    d.limit = (unsigned) size - 1;
    addr = ((unsigned long) rmpara) << 4L;
    d.addr_lo = (unsigned) addr;
    d.addr_hi = (unsigned char) (addr >> 16);
    d.reserved = d.addr_xhi = 0;
    dpmi_set_descriptor(sel, &d);
    *psel = sel;
    return 0;        /* success */
}
unsigned DosFreeSeg(unsigned sel)
{
    return ! dpmi_sel_free(sel);
}

/*
    Use undocumented Windows function to retrieve the real-mode
    equivalent to a protected mode pointer. Of course, we could also
    have used dpmi_get_descriptor() here, but GetSelectorBase()
    is slightly more convenient. If the base of the selector is
    above the one-megabyte watershed, then there is no real-mode
    equivalent, so we return NULL.
*/
void far *DosProtToReal(void far *prot)
{
    unsigned long base = GetSelectorBase(FP_SEG(prot));
    if (base > 0xFFFFFL)
        return NULL;    /* not accessible in real mode */
    else
        return MAKEP(base >> 4, (base & 0x0F) + FP_OFF(prot));
}

unsigned __0000H = 0;   /* undocumented Windows selector */
```

Figure 7: The source code for DPMI.EXE.

DPMI.C 2 of 2

```
unsigned mapped = 0;    /* keep track of number of mapped selectors */

unsigned get_mapped(void)   { return mapped; }

/*
    Map a real-mode pointer into our protected mode address space.
    If the real-mode pointer is in the first 64k of memory, use the
    undocumented Windows selector __0000H. Otherwise, use DPMI
    services via our DosMapRealSeg() function, which provides a more
    convenient layer on top of DPMI. This map_real() function in
    turn provides a more convenient layer on top of DosMapRealSeg().
    Note that DosMapRealSeg() takes a paragraph address, whereas
    map_real takes a full segment:offset real-mode pointer.
*/
void far *map_real(void far *rptr, unsigned long size)
{
    unsigned seg, ofs, sel;

    if (! __0000H)  /* one time init: get undocumented Windows selector */
        __0000H = LOWORD(GetProcAddress(GetModuleHandle("KERNEL"),"__0000H"));

    seg = FP_SEG(rptr);
    ofs = FP_OFF(rptr);
    if ((seg < 0x1000) && ((ofs + size) < 0xFFFF))
        return MAKEP(__0000H, (seg << 4) + ofs);
    if (DosMapRealSeg(seg, size + ofs, &sel) != 0)
        return 0;
    mapped++;
    return MAKEP(sel, ofs);
}

void free_mapped_seg(void far *fp)
{
    unsigned sel = FP_SEG(fp);
    if (sel == __0000H)
        return;
    if (DosFreeSeg(sel) == 0)
        mapped--;
}

/* Use Intel VERW instruction to validate pointers */
unsigned verw(unsigned sel)
{
    _asm mov ax, 1
    _asm verw sel
    _asm je short ok
    _asm xor ax, ax
ok:;
}
```

C interfaces in DPMI.C) used when DEV.C calls map_real() are these:

- Allocate LDT Descriptors (INT 31h AX=0000h); dpmi_sel()
- Get Descriptor (INT 31h AX=000Bh); dpmi_get_descriptor()
- Set Descriptor (INT 31h AX=000Ch); dpmi_set_descriptor()

LDT? Descriptor? It's hard to see what all this has to do with accessing real-mode absolute memory locations from a protected-mode program. In last issue's Lab Notes, however, you'll recall that in protected mode, the *XXXX* portion of an *XXXX:YYYY* pointer is called a selector, and that this selector is effectively an index into what is called a "descriptor table." This is in contrast to real mode, in which an *XXXX:YYYY* pointer (1234:0005, for example) is merely a slightly warped representation of an absolute memory address like 12345h.

Memory addressing in protected mode is indirect. Thus, the absolute memory address that corresponds to a protected-mode pointer of 1234:0005 depends entirely on the "base address" that is stored in the descriptor corresponding to selector 1234h. It bears no relation to the value of the selector itself. In *Windows* 3.0, all *Windows* programs share a common table of such descriptors, called the Local Descriptor Table (LDT). All memory references from *Windows* programs essentially go through the LDT.

This indirection is part of the mechanism that the Intel processors use to enforce protection. It is also why we can't peek at addresses such as 12345h simply by forming a pointer that looks like 1234:0005 (or, more likely, peek at an address such as 046Ch simply by forming a pointer that looks like 0040:006C or 0000:046C). In protected-mode *Windows*, selectors such as 1234h and 0040h are simply being used as indexes for table lookup in the LDT. (Technically, this is something of an oversimplification of the wonderfully baroque mechanism actually used in the Intel processors. For the actual bit-by-bit details, see Ray Duncan et al., *Extending DOS* (Reading Mass.: Addison-Wesley, 1990, or Jeff Prosise, "Segmented Memory," *PC Magazine*, March 26, 1991.))

> In *Windows* 3.0, all *Windows* programs share a table of descriptors known as the Local Descriptor Table, and all memory references essentially pass through it.

Fortunately, however, the indirection does more than cause a problem for protected-mode *Windows* applications; it also provides the solution to the problem. After all, if you want to examine address 46Ch, for example, you don't really care what the *XXXX:YYYY* pointer looks like. If there were a protected-mode descriptor somewhere whose base address was 400h, you could use a selector that corresponded to this descriptor, even if the selector value itself bore no resemblance to the number 40, 400, or whatever. And you could always save the selector in a variable called my40, bios_seg, or perhaps __0040H.

In order to access absolute memory locations in protected mode, then, what you need is to get a selector whose associated descriptor has a base address, limit, and access-rights that correspond to the absolute address you're interested in. And that's exactly the sort of service DPMI provides.

In the DPMI.C program, the DosMapRealSeg() function first calls dpmi_sel() to allocate an LDT descriptor and return its corresponding selector. Next it calls dpmi_get_descriptor() to get a descriptor for *any* data segment in your program, to serve as a kind of "template" for the new descriptor. Then it alters the descriptor to reflect the base address and size requested (for example, sizeof(DeviceHeader) bytes starting at 106E:0000). Finally, you install this altered descriptor using the dpmi_set_descriptor() call. Presto! The selector now corresponds to a descriptor with the base-address and size that the caller requested. The only thing that the caller needs back is the selector, which the function returns.

As I mentioned earlier, you can use the map_real() function without understanding any of this explanation, but knowledge of how protected mode works and of how to use DPMI is going to be increasingly valuable.

Lab Notes

A LIMITED RESOURCE

Returning to the code for DEV.C (Figure 8), note that the map_real() function is called in a loop as DEV walks the DOS device chain. This loop—which is actually the central part of the program—has been excerpted for greater clarity in Figure 9, and can be contrasted with the real-mode code shown previously in Figure 2. Comparing Figure 2 with Figure 9 will show you the major difference between the real-mode and protected-mode versions of the program.

In addition to calling map_real() in the loop, the free_mapped_seg() function in DPMI.C is also called upon to free up mapped selectors. This is extremely important, because descriptors and their corresponding selectors are a precious limited resource. Remember, all *Windows* programs (at least in Version 3.0) share a common LDT, and this can hold a maximum of only 8,192 descriptors.

Freeing mapped selectors is so important that the map_real() and free_mapped_seg() functions in DPMI.C keep track of how many outstanding mapped selectors there are. Just before DEV.C is ready to exit, it checks to make sure no mapped selectors have been left behind, for these are *not* automatically freed when a *Windows* program terminates.

UNDOCUMENTED WINDOWS

If you recall its original purpose, the DEV program needs to print out not only the name of each DOS device driver, but also its address. Although DEV in *Windows uses* a protected-mode address returned from the map_real() function, this is not the address you want printed to the display. The protected-mode address is an arbitrary value that bears no relation at all to the real-mode address that would make sense to the DEV program user.

Thus, you want to display the real-mode address that corresponds to the protected-mode address. Since this real-mode address is whatever value was passed into map_real() in the first place, you could, of course, have saved it away somewhere for

DEV.C 1 of 2

```
/*
DEV.C -- display MS-DOS device chain

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    PC Magazine * Andrew Schulman

real mode:
    Borland C++ 2.0: bcc dev.c
    Microsoft C 6.0: cl dev.c

Borland C++ 2.0 (DPMI.C *must* be compiled with -B flag):
    bcc -W -DWINDOWS -2 -B dev.c printf.c dpmi.c
    rc dev.exe

Microsoft C 6.0:
    cl -c -AS -G2sw -Oais -Zpe -W3 -DWINDOWS dev.c printf.c dpmi.c
    link /align:16 dev dpmi printf,dev,,/nod slibcew libw,win.def
    rc dev.exe

WIN.DEF:
    ; WIN.DEF -- generic Windows .DEF file
    EXETYPE         WINDOWS
    STUB            'WINSTUB.EXE'
    CODE            PRELOAD MOVEABLE DISCARDABLE
    DATA            PRELOAD MOVEABLE MULTIPLE
    HEAPSIZE        10240
    STACKSIZE       5120
*/

#include <stdlib.h>
#include <stdio.h>
#include <string.h>
#include <dos.h>
#ifdef WINDOWS
#include <windows.h>
#include "dpmi.h"
#include "printf.h"
#endif

#ifdef WINDOWS
char *app = "Walk DOS Device Chain";
#define puts(s)   MessageBox(NULL, s, app, MB_OK)
#endif
#define fail(s)   return puts(s)

#ifndef MK_FP
#define MK_FP(seg, ofs) \
    ((void far *) (((unsigned long) (seg) << 16) | (ofs)))
#endif

/* some device attribute bits */
#define CHAR_DEV     (1 << 15)
#define INT29        (1 << 4)
#define IS_CLOCK     (1 << 3)
#define IS_NUL       (1 << 2)

#pragma pack(1)

typedef struct DeviceDriver {
    struct DeviceDriver far *next;
    unsigned attr;
    unsigned strategy;
    unsigned intr;
    union {
        unsigned char name[8];
        unsigned char blk_cnt;
        } u;
    } DeviceDriver;

typedef struct {
    unsigned char misc[8];
    DeviceDriver far *clock;
    DeviceDriver far *con;
    unsigned char misc2[18];
    DeviceDriver nul;   /* not a pointer */
    // ...

    } ListOfLists;  // DOS 3.1+

ListOfLists far *get_doslist(void)
{
#ifdef WINDOWS
    /*
        Call undocumented DOS INT 21h Function 52h via DPMI "Simulate
        Real Mode Interrupt" call (INT 31h AX=0300h), and return
        the resulting real-mode pointer
    */
    RMODE_CALL r;
    memset(&r, 0, sizeof(r));
    r.eax = 0x5200;
    return (dpmi_rmode_intr(0x21, 0, 0, &r)) ? MK_FP(r.es, r.ebx) : 0;
#else
    union REGS r;
    struct SREGS s;
    segread(&s);
    s.es = r.x.bx = 0;
    r.h.ah = 0x52;
    intdosx(&r, &r, &s);
    return MK_FP(s.es, r.x.bx);
#endif
}

#ifdef WINDOWS
int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
    LPSTR lpszCmdLine, int nCmdShow)
#else
int main(int argc, char *argv[])
#endif
{
    ListOfLists far *doslist;
    DeviceDriver far *dd;
#ifdef WINDOWS
    DeviceDriver far *next;
    int mapped;
#endif

#ifdef WINDOWS
    if (!(GetWinFlags() & WF_PMODE))
        fail("This program requires Windows Standard or Enhanced mode");

    if (! dpmi_present())
        fail("This program requires DPMI INT 31h services");
#endif

    if (! (doslist = get_doslist()))
        fail("INT 21h Function 52h not supported");

#ifdef WINDOWS
    /* get protected-mode pointer to DOS internal variable table */
    doslist = map_real(doslist, sizeof(ListOfLists));

    open_display(app);
#endif

    /* This block of code double-checks that everything is ok */
    /* NUL is part of DOSLIST, not a pointer, so don't need to map */
    if ( fmemcmp(doslist->nul.u.name, "NUL     ", 8) != 0)
        fail("NUL name wrong");
    if (! (doslist->nul.attr & IS_NUL))
        fail("NUL attr wrong");
```

Figure 8: Walking the device chain in protected-mode *Windows* is achieved by DEV.C.

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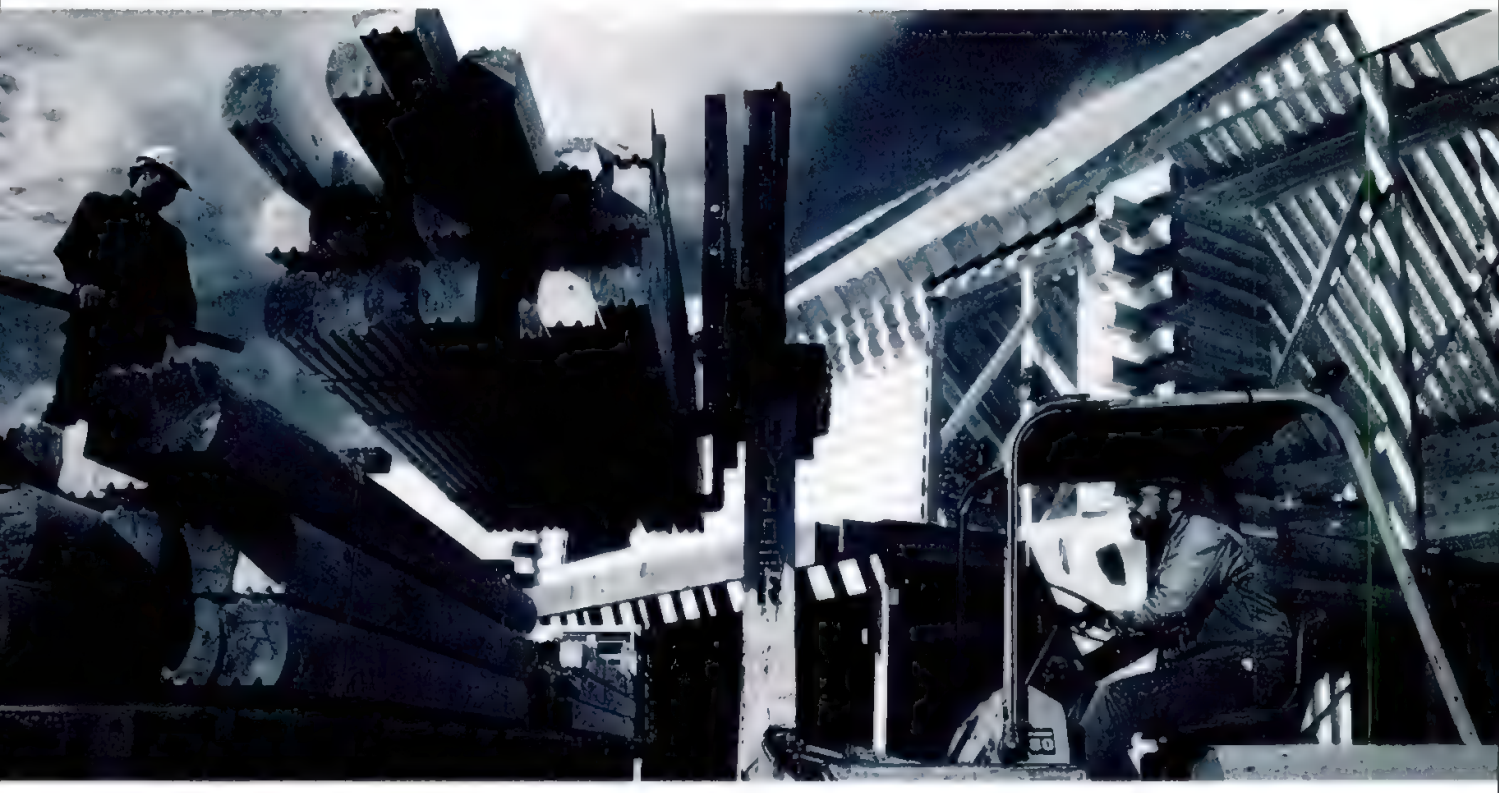

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DEV.C 2 of 2

```
#ifdef WINDOWS
    /* CON is pointer, so need to map */
    dd = map_real(doslist->con, sizeof(DeviceDriver));
#else
    dd = doslist->con;
#endif
    if (_fmemcmp(dd->u.name, "CON     ", 8) != 8)
        fail("CON name wrong");
    if (! (dd->attr & CHAR_DEV))
        fail("CON attr wrong");
#ifdef WINDOWS
    free_mapped_seg(dd);
#endif

#ifdef WINDOWS
    /* CLOCK$ is also pointer, so need to map */
    dd = map_real(doslist->clock, sizeof(DeviceDriver));
#else
    dd = doslist->clock;
#endif
    if (_fmemcmp(dd->u.name, "CLOCK$  ", 8) != 8)
        fail("CLOCK$ name wrong");
    if (! (dd->attr & IS_CLOCK))
        fail("CLOCK$ attr wrong");
#ifdef WINDOWS
    free_mapped_seg(dd);
#endif

    /* print out device chain */
    dd = &doslist->nul;
#ifdef WINDOWS
    for (;;)
    {
        printf("%Fp    ", DosProtToReal(dd)); /* print real-mode addr */
        if (dd->attr & CHAR_DEV)
            printf("%.8Fs\r\n", dd->u.name);
        else
            printf("Block dev: %u unit(s)\r\n", dd->u.blk_cnt);
        next = dd->next;            /* get next pointer */
        /* first time through, this will free selector to doslist */
        free_mapped_seg(dd);        /* THEN free rmode seg */
        if (FP_OFF(next) == -1)     /* is there a next? */
            break;
        dd = map_real(next, sizeof(DeviceDriver));  /* map it */
        Yield();    /* no message loop in this program, so yield */
    }
#else
    do {
        printf("%Fp\t", dd);
        if (dd->attr & CHAR_DEV)
            printf("%.8Fs\n", dd->u.name);
        else
            printf("Block dev: %u unit(s)\n", dd->u.blk_cnt);
        dd = dd->next;
    } while (FP_OFF(dd->next) != -1);
#endif

#ifdef WINDOWS
    if (mapped = get_mapped())
        printf("%u remaining mapped selectors!\r\n", mapped);
    show_display();
    return mapped;  /* 0 indicates success */
#else
    return 0;
#endif
}
```

DEV.C PARTIAL LISTING

```
ListOfLists far *doslist;
DeviceDriver far *dd;
// ...
dd = &doslist->nul;
for (;;)
{
    printf("%Fp    ", DosProtToReal(dd)); /* print real-mode addr */
    if (dd->attr & CHAR_DEV)
        printf("%.8Fs\r\n", dd->u.name);
    else
        printf("Block dev: %u unit(s)\r\n", dd->u.blk_cnt);
    next = dd->next;            /* get next pointer */
    /* first time through, this will free selector to doslist */
    free_mapped_seg(dd);        /* THEN free rmode seg */
    if (FP_OFF(next) == -1)     /* is there a next? */
        break;                  /* if not, we're done */
    dd = map_real(next, sizeof(DeviceDriver));  /* map it */
    Yield();  /* no message loop in this program, so yield */
}
```

Figure 9: The loop within DEV.C that walks the device chain. For an idea of the differences between real- and protected-mode, compare this to Figure 2.

later use before calling map_real().

Instead, however, DEV.C calls the DosProtToReal() function that was implemented in DPMI.C. Given a protected-mode pointer, this function attempts to return the corresponding real-mode pointer. The word "attempts" is important here, because if the base address for the protected-mode pointer is above the 1MB Maginot Line, then the protected-mode pointer has no real-mode counterpart.

In any case, DosProtToReal() attempts to make the conversion. Just for variety, rather than calling the dpmi_get_descriptor() function, it calls an undocumented *Windows* function, GetSelectorBase(). If the base address of the selector is greater than FFFFFh, then the pointer cannot be converted. Otherwise, DosProtToReal() combines the selector's base address with the protected-mode pointer's offset to form the desired real-mode pointer.

The GetSelectorBase() function used here is one of several such undocumented *Windows* functions. The function prototypes for several others are shown in DPMI.H (Figure 6). In fact, I could have used the SetSelectorBase() and SetSelectorLimit() functions, together with the documented *Windows* function AllocSelector(), and avoided DPMI entirely.

With regard to using undocumented functions, it's well to remember that there is no guarantee that they will continue to be supported in future releases of *Windows*—or even that they work 100 percent of the time in this release. That may be why they're undocumented in the first place!

On the other hand, these undocumented *Windows* functions really are far more convenient than the raw DPMI interrupt 31h functions. Further, in my experience, they have always worked—or at least worked as well as anything else in *Windows* 3.0. The tiny UNDOCSEL.C program listed in Figure 10 shows how these functions would be used to print out the BIOS timer-tick count at absolute memory location 46Ch (real-mode pointer 0040:006C).

Map_real() also makes use of an undocumented *Windows* feature: the __0000H selector. This is a hard-wired selector maintained by *Windows* that maps the 64K block of memory beginning at absolute memory location zero. Since many of the DOS device headers will be located in this first 64K of memory, it just made sense to use the *Windows* selector in this case.

Microsoft's *Windows Guide to Programming* (Chapter 16, "More Memory Management") describes global selectors such as __B000H and __B800H. These are used by full-screen *Windows* applications that do direct screen writes, such as Turbo Debugger for *Windows* (TDW) and the new single-screen version of CodeView for *Windows* (CVW). Note, however, that the Microsoft documentation does not mention the extremely useful __0000H selector.

UNDOCSEL.C COMPLETE LISTING

```
/*
UNDOCSEL.C -- illustrates undocumented Windows selector functions

cl -c -AS -G2sw -Oais -Zpe undocsel.c printf.c
link /align:16 undocsel printf,undocsel,,/nod slibcew libw,win.def
rc undocsel.exe

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*/

#include <windows.h>
#include <dos.h>
#include "printf.h"

/* undocumented Windows functions */
extern DWORD FAR PASCAL GetSelectorBase(unsigned sel);
extern DWORD FAR PASCAL GetSelectorLimit(unsigned sel);
extern void FAR PASCAL SetSelectorBase(unsigned sel, DWORD base);
extern void FAR PASCAL SetSelectorLimit(unsigned sel, DWORD limit);

#define FAIL(s) return MessageBox(NULL, s, "UNDOCSEL", MB_OK), 0

int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
    LPSTR lpszCmdLine, int nCmdShow)
{
    unsigned sel, _ds;
    unsigned long far *pticks;
    if (! (GetWinFlags() & WF_PMODE))
        FAIL("This program requires Windows Standard or Enhanced mode");
    open_display("Undocumented Selector Function Test");
    _asm mov _ds, ds
    sel = AllocSelector(_ds);          // copy DS
    printf("sel=%04X\n", sel);
    SetSelectorBase(sel, 0x400);       // BIOS data area
    SetSelectorLimit(sel, 0xFFFF);     // only 64k allowed
    FP_SEG(pticks) = sel;
    FP_OFF(pticks) = 0x6c;             // BIOS timer tick
    printf("base=%08lx limit=%08lx ticks=%08lX\n",
        GetSelectorBase(sel), GetSelectorLimit(sel), *pticks);
    show_display();
    FreeSelector(sel);
}
```

Figure 10: The source code, UNDOCSEL.C, that uses an undocumented *Windows* function to print out the BIOS timer-tick count.

According to the Microsoft documentation, these global selectors are usable only from an assembly language program. The code in map_real() shows one way that __0000H can be accessed from a C program, however, and the other global selectors can be accessed in a similar fashion. One note of caution is in order: There is another undocumented selector, __0040H, which you would think mapped the BIOS data area at address 400h. In fact, this selector maps only the 2FFh bytes at address 0. Another undocumented selector, __ROMBIOS, is merely an alias for __F000H.

WINDOWS AND DPMI

Having now seen how to call DPMI from *Windows* programs and how *Windows* provides its own undocumented layer on top of DPMI, it is natural to ask how DPMI fits into the *Windows* API.

GlobalDOSAlloc() will be very important for *Windows* developers who need access to conventional memory.

You won't see DPMI mentioned in Microsoft's *Windows* documentation. In fact the Microsoft documentation barely refers to protected mode or to the fact that *Windows* in Standard and 386 Enhanced modes is a DOS extender. For many years, *Windows* essentially *faked* protected mode in software and even required developers to do a lot of work to help maintain the fiction. Now that *Windows* programs really do run in protected mode, most of the memory-management nonsense formerly required of *Windows* programs has disappeared. However, Microsoft's documentation barely mentions this either, and it downplays the massive change wrought by *Windows* 3.0 under the diplomatic title, "improved memory management."

Microsoft's only explicit mention of DPMI is a brief five-page document titled "Windows INT 21H and NetBIOS Support for DPMI," which is included in a packet of *Microsoft Windows* development notes (Part No. 050-030-313).

According to this rather obscure document, only a handful of DPMI functions should be used from *Windows* programs. The supported functions (which are listed on page 390 of *PC Magazine*'s February 26, 1991, issue) are those that set and get real-mode interrupt vectors, generate real-mode software interrupts, and call real-mode code.

For example, INT 31h AX=0300h (Simulate Real Mode Interrupt), together with the *Windows* function GlobalDosAlloc(), can be used for generating software interrupts not supported in protected mode. We will see an example of this toward the end of this article, in the short program TRUENAME.C.

According to Microsoft, apart from those listed, no other DPMI functions "are required for *Windows* applications, since the Kernel provides functions for allocating memory, manipulating descriptors, and locking memory."

Unfortunately, many developers have found that the *Windows* Kernel, even combined with the few "supported" DPMI functions, does *not* in fact provide everything they need to talk to real-mode TSRs, network drivers, and the like.

Again, the problem is this: Given a block of memory at an absolute real-mode address (such as the BIOS data area or the DOS device chain), how do you access this memory from your protected-mode *Windows* program? Even with the undocumented __0000H selector and the documented selectors such as __A000H, there is still an inaccessible hole between 10000h and A0000h!

The choice is either to use the undocumented SetSelectorBase() and SetSelectorLimit() functions, as in UNDOCSEL.C (Figure 10), or to use DPMI directly. The ability to map an arbitrary real-mode address into a program's protected-mode ad-

WINDOWS AND PRINTF()

by Andrew Schulman

The first problem you face when porting a PC program to *Microsoft Windows* is that you can't use such familiar output functions as printf() in C or Write() in Turbo Pascal. Instead, you must employ *Windows* functions like TextOut() or DrawText(). And, of course, you must completely restructure the program so that it responds to *Windows* "events."

Of course? The familiar claim that "it takes 100 lines even to say 'hello world' in *Windows*," is often repeated even by die-hard *Windows* evangelists. (The latter may indeed see such complexity as a virtue!) This gives the mistaken impression that even the smallest one-liner must be restructured as a full-blown *Windows* program, complete with a WndProc message handler and calls to the RegisterClass() and CreateWindow() functions.

Such a misconception makes it extremely difficult for newcomers to get started in *Windows* programming, and it inhibits experienced developers from trying to write tiny utilities or throw-away experiments.

It is true that if you use Microsoft C or Borland C++, you'll find that all the standard input/output (stdio) functions, such as printf(), puts(), and gets(), have been yanked from the *Windows* libraries. Trying to call one of these functions from a *Windows* program causes the linker to generate an "unresolved external."

But there is nothing magical about printf() or any other stdio function; stdio libraries can be built *on top of* the *Windows* API. For example, using Borland's *Turbo Pascal for Windows* (TPW), if you simply change the Pascal statement "Uses Crt" in a program to "Uses WinCrt," you've essentially created an instant *Windows* application: all your calls to the Pascal Write() statement go to a *Windows* window. Obviously, the same thing can be done in C or C++. In fact one wonders why Borland hasn't done it. In any case, it's relatively easy to write a module that allows its users to bring up *Windows* applications without rubbing their noses in the *Windows* API.

As we saw in last issue's Lab Notes, the *Windows* MessageBox() function can produce an entire screen of output. This makes it handy for tiny utilities like DEV. Alternatively, you can take advantage of *Windows*' multitasking and interprocess messaging to use another program (such as Notepad) as

PRINTF.H — COMPLETE LISTING

```
/* PRINTF.H */

BOOL open_display(char *appname);
BOOL show_display(void);
int printf(const char *fmt, ...);
BOOL notepad(char far *s);
```

Figure A: The header file for the *Windows* version of printf().

PRINTF.C — 1 of 2

```
/*
PRINTF.C -- simple output for small Windows programs,
using MessageBox() or WinExec()/SendMessage()

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*/

#include <stdlib.h>
#include <stdarg.h>
#include <string.h>
#include <windows.h>
#include "printf.h"

#define BUF_SIZE        1024

static char *str, *app;
static unsigned cap, len;
static int lines;

BOOL open_display(char *appname)
{
    app = appname;
    cap = 128;
    if (! (str = malloc(cap)))
        return FALSE;
    *str = lines = len = 0;
    return TRUE;
}

/* Maximum number of lines that MessageBox will hold */
static int max_lines(void)
{
    TEXTMETRIC tm;
    HWND hWnd = GetActiveWindow();
    HDC hDC = GetWindowDC(hWnd);
    if (hDC == NULL)
        return 0;
    GetTextMetrics(hDC, &tm);
    ReleaseDC(hWnd, hDC);
    return (GetSystemMetrics(SM_CYFULLSCREEN) /
        (tm.tmHeight + tm.tmExternalLeading)) - 5;
}

BOOL show_display(void)
{
    if (lines <= max_lines())
        MessageBox(NULL, str, app, MB_OK);
    else
        notepad(str);
    free(str);
    return TRUE;
}

static BOOL append(char *s2)
{
    char *s3;
    if (((len += strlen(s2)) < cap) && strcat(str, s2))
        return TRUE;
    cap = len + 128;
    if (! (s3 = malloc(cap)))
        return FALSE;
    strcpy(s3, str);
    strcat(s3, s2);
    free(str);
    str = s3;
    return TRUE;
}

int nlines(char *s2)
{
    int c, n = 0;
    while (c = *s2++)
        if (c == '\n')
            n++;
```

Figure B: PRINTF.C provides a *Windows* version of printf() for simple output.

CONTINUES

CONTINUED

PRINTF.C 2 of 2

```
    return n;
}

int printf(ccnst char *fmt, ...)
{
    static char s2[BUF_SIZE];
    int len;
    va_list marker;
    va_start(marker, fmt);
    len = vsprintf(s2, fmt, marker);
    lines += nlines(s2);
    va_end(marker);
    append(s2);
    return len;
}

BOOL notepad(char far *s)
{
    HWND notepad;
    HWND edit_ctrl;
    if (WinExec("notepad.exe", SW_SHOWNORMAL) < 32)
        return FALSE;
    notepad = FindWindow(NULL, "Notepad - (untitled)");
    edit_ctrl = GetFocus();
    SendMessage(notepad, WM_SETTEXT, 0, (char far *) app);
    SendMessage(edit_ctrl, WM_SETTEXT, 0, (char far *) s);
    return TRUE;
}

#ifdef TESTING
int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
    LPSTR lpszCmdLine, int nCmdShow)
{
    int i;
    open_display("GetSystemMetrics");
    for (i=0; i<37; i++)
    {
        printf("%d\tad\r\n", i, GetSystemMetrics(i));
        Yield();
    }
    show_display();
}
#endif
```

your "display engine." Functions such as printf() can then be written on top of, and in terms of, such lower-level capabilities.

DEV.C, listed in Figure 8 of the main article, looks a lot simpler than most *Windows* source code. It doesn't register a class, call CreateWindow(), or handle messages. Instead, it calls printf(). When compiling for *Windows*, however, it uses the new version of printf() supplied by PRINTF.H and PRINTF.C, listed in Figures A and B. Here, printf() simply accumulates text until a call to show_display(). The show_display() function uses the *Windows* MessageBox() function.

If there is more text than MessageBox() can handle, then PRINTF.C uses WinExec() to fire up a copy of Notepad and sends the text to Notepad using the WM_SETTEXT message and the SendMessage() function. The ability of one program to send text to another shows, incidentally, that *Windows* is genuinely message-based: "messages" are a true form of interprocess communication, not just an elaborate way of describing a function call.

Windows itself can sometimes help in the task of providing a *Windows*-based printf(). The *Windows* dynamic-link library USER.EXE provides the functions wsprintf() and wvsprintf(). Like the vsprintf() of ANSI C, the wvsprintf() function can be used to construct other functions—such as printf()—that take a variable number of arguments. Because wvsprintf() resides in a DLL, using this *Windows* version of the function can reduce the size of your executable.

Unfortunately, wvsprintf() does not support several useful "masks," such as %Fp. It is also sometimes awkward to use: Since it resides in a DLL, it expects all strings to be passed as far pointers. In PRINTF.C, therefore, I ended up using the non-*Windows* vsprintf() function.

In porting DEV.C to *Windows*, in any case, you can simply assume that you have a function called printf() that takes the same parameters and returns the same value (almost always ignored!) as the "regular" printf(), but that somehow "does the right thing" in displaying output under *Windows*. Thus, it really is possible to write simple *Windows* programs! ■

dress space was left out of the published API, making DPMI even more necessary for *Windows* developers than Microsoft's brief description would indicate.

USING GLOBALDOSALLOC()

One documented *Windows* function that will be quite important for many developers who need to access conventional memory or call real-mode TSRs and drivers is GlobalDosAlloc(). This function allocates a block of conventional memory, returning both a real-mode paragraph address and a protected-mode selector to the memory.

Suppose, for example, that you're writing a piece of network software for *Windows* using a specification like NetBIOS or Novell IPX/SPX. In addition to needing dpmi_rmode_intr() (or its underlying DPMI Simulate Real Mode Interrupt call, INT 31h AX=0300h) to generate the real-mode software interrupt, you must also pay attention to any buffers expected by the network driver.

The NetBIOS INT 5Ch interface, for instance, expects a pointer to a Network Control Block (NCB) in ES:BX. When calling this from protected mode, even though you are going through the DPMI Simulate Real Mode Interrupt call, you must ensure (1) that the NCB is in conventional memory and (2) that ES:BX has a real-mode pointer. On the other hand, your program must manipulate the same NCB using a protected-mode pointer.

That's where GlobalDosAlloc() comes in. By allocating out of conventional memory and giving back both a real-mode paragraph address and a protected-mode selector, it's exactly the function you need to use in conjunction with dpmi_rmode_intr(). I found the *way* that GlobalDosAlloc() returns these two different values annoying, so I constructed another function on top of it, DosAllocRealSeg(). (Like the earlier DosMapRealSeg(), the name comes from the Phar Lap API.)

The GlobalDosAlloc() function (implemented via the more convenient DosAllocRealSeg()) and dpmi_rmode_intr(), are used in TRUENAME.C (Figure 11), the last tiny *Windows* program presented here. Because many readers don't have NetBIOS, I have again used an undocumented DOS call—the one category I know is available on every DOS machine, yet which is not supported directly from

TRUENAME.C — **COMPLETE LISTING**

```
/* truename.c */

#include <windows.h>
#include <stdlib.h>
#include <ctype.h>
#include "printf.h"
#include "dpmi.h"

#define fail(s)             { MessageBox(NULL, s, "TRUENAME", MB_OK); exit(1); }

#define MAKEP(seg, ofs) ((void far *) MAKELONG((ofs), (seg)))

char far *truename(char far *s, char far *d)
{
            RMODE_CALL r;
            unsigned para, sel;
    char far *s2;

    /* INT 21h AH=60h doesn't like leading or trailing blanks */
    while (isspace(*s)) s++;
    s2 = s;
    while (*s2) s2++;
    s2--;
    while (isspace(*s2)) *s2-- = 0;

            if (DosAllocRealSeg(256, &para, &sel) != 0)
                        fail("Couldn't allocate real-mode memory");
            memset(&r, 0, sizeof(r));
            r.eax = 0x6000;
            r.ds = r.es = para;
            r.esi = 0;
            r.edi = 128;
            lstrcpy(MAKEP(sel, 0), s);
            if (! dpmi_rmode_intr(0x21, 0, 0, &r))
                        fail("DPMI real-mode intr failed");
            lstrcpy(d, (r.flags & 1) ? "<Invalid>" : (char far *) MAKEP(sel, 128));
            if (DosFreeRealSeg(sel) != 0)
                        fail("Couldn't free real-mode memory");
            return d;
}

int PASCAL WinMain(HANDLE hInstance, HANDLE hPrevInstance,
            LPSTR lpszCmdLine, int nCmdShow)
{
            char buf[128];
            if (! (GetWinFlags() & WF_PMODE))
                        fail("This program requires Windows Standard or Enhanced mode");
            if (! (lpszCmdLine && *lpszCmdLine))
                        fail("syntax: truename <pathname>");
            sprintf(buf, "TRUENAME %Fs", lpszCmdLine);
            open_display(buf);
            printf("%Fs\n", truename(lpszCmdLine, buf));
            show_display();
```

Figure 11: TRUENAME.C shows how to pass a conventional memory buffer to a real-mode interrupt.

protected-mode *Windows*.

The TRUENAME program takes a pathname from the command line (for example, the Program Manager Run . . . command) and uses INT 21h AH=60h to return the "true" underlying pathname, with any DOS ASSIGNs, SUBSTs, JOINs, or network mappings resolved. On my machine at work, for example, drive F: is actually located on a Sun SPARCstation, and running TRUENAME F: displays something like

```
\\EXPORT\DOS\A_ANDREW.
```

The reason this program is a good illustration of using GlobalDosAlloc() together with dpmi_rmode_intr(), is that INT 21h AH=60h expects a source pathname in DS:SI (such as "F:."), and a pointer to a 128-byte destination buffer in ES:DI (into which it will place a string such as "\\EXPORT\DOS\A_ANDREW"). Before calling INT 21h AH=60h, the program must allocate a conventional-memory transfer buffer, copy the source string into it, put its real-mode address in DS:SI, and put the address of another conventional-memory transfer buffer (the destination) in ES:DI. When dpmi_rmode_intr() returns after INT 21h AH=60h has been invoked, you can copy the results out of the conventional-memory buffer. Of course, you must do this copying using the protected-mode pointer to the buffer.

A GOOD PROBLEM

There are many ways that *Windows* programs can use DPMI. Other DPMI services I haven't discussed here let programs hook real-mode interrupt vectors, enhance debugging with access to protected-mode data structures such as the Global Descriptor Table (GDT), and catch GP faults and other exceptions.

This last-mentioned possibility is really quite interesting. I earlier talked about the GP fault and UAE as if they were an immutable fact of protected-mode life. In fact, however, the GP fault is nothing but an interrupt 0Dh. DPMI makes a distinction between interrupts and processor exceptions and provides functions for handling exceptions like the GP fault.

The DPMI Set Processor Exception Handler Vector (INT 31h AX=0203h) and the Get Processor Exception Handler Vector (INT 31h AX=0202h) calls can be used to replace *Windows*' annoying UAE with your own GP fault handler. Such a handler might display a message box politely asking the end user of a program that has GP faulted to call tech support, for example. Anything would be better than hitting the user with the "Unrecoverable Application Error" message!

Amidst all the complexities of protected-mode *Windows*, it's a good idea to conclude by remembering the tremendous advantages brought about by the demolition of the 1MB "Berlin Wall." These far outweigh any disadvantages resulting from the sudden inability to examine address 400h with the pointer 0000:0400, for example. In any case, this discussion has shown that you can still examine the memory at 400h; it's just that you can't do it with the pointer 0000:0400 or 0040:0000. Instead, you have to use whatever equivalent protected-mode pointer is returned from map_real(), from the underlying DPMI calls, or from a combination of undocumented *Windows* calls.

The problem with low-level access from protected mode reflects PC programming's move to a new, higher level. We have broken the 640K barrier, but we have not shed our massive investment in DOS software. The programming problems demonstrated in this and the previous Lab Notes represent the *successful* compromise between protected mode and DOS. More and more programs are running in protected mode, yet the industry's investment in DOS has been preserved. This is a good problem to have! ■

Andrew Schulman is an engineer and writer at Phar Lap Software, in Cambridge, Massachusetts. Editor of the recent book Undocumented DOS, *he is also a contributor to* Extending DOS, *edited by Ray Duncan.*

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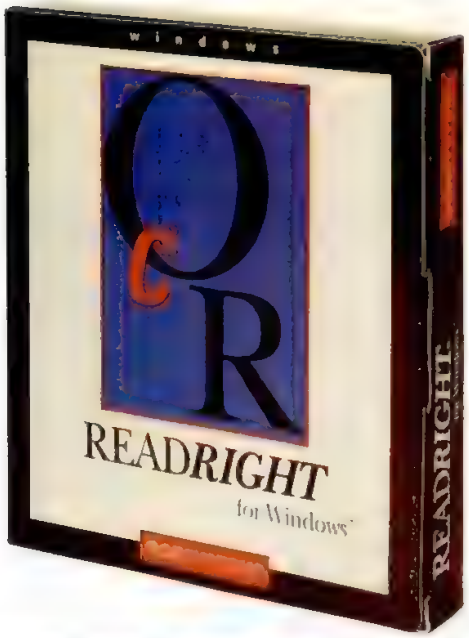

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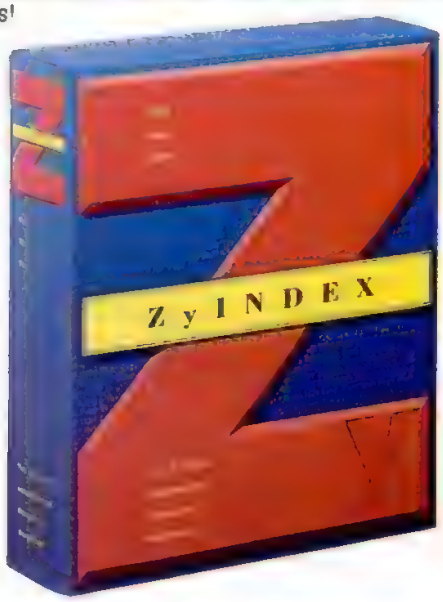

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CIRCLE 261 ON READER SERVICE CARD

by
Fran Finnegan

Utilities

Extend Your WIN.INI Extensions with WINEXT.EXE

One of the convenient things about *Microsoft Windows* 3.0 is that simply by selecting a document or data file, you can bring it up under the application that understands it. Double-click on README.TXT from the File Manager or MS-DOS Executive file listing of *Windows*' main directory (usually C:\WINDOWS), and *Windows* somehow *knows* to bring it up under Notepad. The same thing happens if you pick File Run and enter README.TXT in the dialog box of the Program Manager, File Manager, or MS-DOS Executive. Enter README.TXT on the DOS command line, however, and all you get is "Bad command or filename."

These three *Windows* shells can work this magic because they *associate* specific extensions with specific application programs through the [Extensions] section of your WIN.INI file. You can associate a .DOC extension with *Word for Windows*, for example, so that double-clicking on a .DOC file automatically brings it up under that word processor.

As implemented in the current *Windows* shells, however, association is less convenient than it might be—particularly if you're accustomed to working directly in DOS. In DOS, whether you bring up a program by itself or load it with a data file when you start it (as most DOS applications let you do) you are not switched out of the directory from which you began.

Under *Windows*, however, if you bring up an application by double-clicking on it, the shell leaves you in the directory that contains the application. That's just what my old copy of *Lotus 1-2-3* needs, for that program requires that you start it from its own directory. But if you use a *Windows association* to bring up an application—by double-clicking on a filename in the File Manager file list window, for example—the shell leaves you instead in the directory that contains the data file. If your program requires that it be in the current directory in order to run, you can't start it from a File Manager file list.

Moreover, the standard *Windows* shells do not pass fully qualified (*d:\path\filename.ext*) filespecs to a DOS or *Windows* program or to a batch file: The filename and extension alone are included. This makes it impossible for a batch file to change directories while retaining the location of the data file, as would be required, for example, by a batch file designed to make backup copies of word processor documents.

■ Our WINEXT utility gives you full control over the command line for applications you start from the *Windows* 3.0 File Manager and Program Manager.

In DOS, there is no way to automatically link the filename to the program that will allow you to view or edit it; you must always precede the filename with a command, program or .BAT filename. Nevertheless, DOS lets you start—and stay—in one directory, call up an application from a second drive and directory, and feed it a data file from still a third drive/directory location. File Manager and MS-DOS Executive, on the other hand, will change the current directory so that you can double-click on the data file. (Note: executing the File Open command will normally let you see where you are in *Windows*. Most programs will display the current working directory in the Open dialog box.)

Thus, although the *Windows* association mechanism automates certain operations in a way that DOS doesn't, it takes away certain basic abilities users have long taken for granted under DOS. To solve this problem, I created WINEXT.EXE. With WINEXT, *Windows* users gain the same control over their directory choices and argument lists that they have when launching an application from the DOS prompt. But they don't lose the power to start applications by choosing associated data files.

WINEXT lets you set the current directory independently of either the data file directory *or* of the directory in which the application resides. No reliance on the PATH environment variable is required. To extend the usefulness of the *Windows* association concept still further, I decided also to build in support for multiple arguments on *both* sides of the caret in a WIN.INI [Extensions] entry. That is, you can make associations with programs that, for example, require some options *before* the filename and some *after*, or that require all their arguments after the filename. As I'll describe below, WINEXT also has the capability of handling multiple carets and substituting for DOS environment variables (delimited by percent signs, just as in .BAT files) in the command line that it creates. And in passing filenames, full filespecs are included so that .BAT files are supported.

The easiest way to obtain a copy of WINEXT.EXE is to download it from PC MagNet (see the PC MagNet page following this article for access instructions). The source code files are included in WINEXT.ZIP, which can also be downloaded from PC MagNet. As an alternative, you can get the *source code* by mail or fax by sending a postcard with your name, address, and fax number (if applicable) to the

A TYPICAL WIN.INI [EXTENSIONS] SECTION

```
[Extensions]
CAL=CALENDAR.EXE ^.CAL
CRD=CARDFILE.EXE ^.CRD
TRM=TERMINAL.EXE ^.TRM
TXT=NOTEPAD.EXE ^.TXT
INI=NOTEPAD.EXE ^.INI
PCX=PBRUSH.EXE ^.PCX
BMP=PBRUSH.EXE ^.BMP
WRI=WRITE EXE ^.WRI
REC=RECORDER EXE ^.REC
XLS=EXCEL.EXE ^.XLS
XLC=EXCEL.EXE ^.XLC
XLW=EXCEL.EXE ^.XLW
XLM=EXCEL.EXE ^.XLM
XLT=EXCEL.EXE ^.XLT
XLA=EXCEL.EXE ^.XLA
DOC=WINWORD.EXE ^.DOC
DOT=WINWORD.EXE ^.DOT
RTF=WINWORD.EXE ^.RTF
C=NOTEPAD.EXE ^.C
DEF=NOTEPAD.EXE ^.DEF
H=NOTEPAD.EXE ^.H
RC=NOTEPAD.EXE ^.RC
EMM=EMAILMAN.EXE ^.EMM
```

Figure 1: Each entry in the WIN.INI [Extensions] section contains a filename extension that identifies a document type, together with the command line to be executed when you choose a file with that extension.

attention of Katherine West, Utilities, *PC Magazine*, One Park Avenue, New York, NY 10016. Note that to create WINEXT from the source code, you will need the *Microsoft Windows* Software Development Kit (SDK) and an SDK-compatible C compiler, or the new Borland C++ for *Windows*.

THE WINEXT CONTEXT

Because WINEXT is designed to be used primarily from within your WIN.INI file, before discussing its syntax, we must briefly consider how *Windows* stores association information, how this information can be updated by the user, and how the file association information is used by the File Manager, the Program Manager, the MS-DOS Executive, and other shell applications. (Longtime *Windows* users and programmers may want to skip directly to the "Using WINEXT" section below.)

The WIN.INI file in your C:\WINDOWS directory consists of various *sections*—groups of settings—that allow you to personalize your *Windows* environment. The name of each section is enclosed in brackets ([]), and it is the [Extensions] section in WIN.INI that makes the association between filename types and the applications linked to them. To look at your WIN.INI file, double-click on it in File Manager or use Program Manager to Run WIN.INI; in either case, Notepad will be brought up with the contents of WIN.INI displayed.

As you can see from Figure 1, the entries in the typical [Extensions] section use the format

```
ext=command ^.ext
```

where *ext* is a document filename extension (one to three characters) and *command* is the name of an application program to be run, followed by any command parameters the application needs. Note that, unlike the commands included in an AUTOEXEC.BAT file, in WIN.INI the application filename must include its .COM, .EXE, or .BAT extension. (If omitted, an .EXE extension is assumed.) The caret (^) character that follows the *command* is handled slightly differently by different shell programs, but its basic purpose is to serve as a marker that will be replaced by the filename of the document to be brought up under the application.

As you can see from Figure 1, you can associate more than one extension with the same application. What you must not do, however, is try to associate a single extension with more than one application. For example, don't associate .DOC with *Microsoft Word* (for DOS) and *Word for Windows;* if you do, *Windows* will always find only the first association and ignore subsequent ones.

You can change the association information kept in WIN.INI in either of two ways. The easier way is to run File Manager, highlight a filename with the extension you want to update, and choose File Associate from the menu. When you update an association this way, you can specify only information that appears to the left of the ^.ext shown in Figure 1 (such as the application and parameters). The File Manager will automatically append ^.ext to anything you enter. You can use this method to implement WINEXT as long as you don't need to put anything to the right of the ^.ext.

The other way to change the association information is to edit your WIN.INI file manually. You can do this (make a backup beforehand!) with Notepad, the System Configuration Editor (SYSEDIT.EXE) or any other text editor. The manual approach lets you edit the *entire* association line and will be necessary if you want to use some of the more-powerful features of WINEXT.EXE. Note that after saving an edited WIN.INI file, you must exit and restart *Windows* for the changes to take effect.

The association information is used by the File Manager, the Program Manager, the MS-DOS Executive—the standard *Windows* shells—and by other applications in similar, but not precisely identical, ways. Each time you double-click on a nonexecutable file, the shell program looks at the WIN.INI [Extensions] section to see if the extension is listed. If it is, the shell retrieves the ext= command line, replaces the ^.ext with the selected filename, and executes the command, leaving you in the directory containing the data file. (Different shells vary slightly in how they handle the caret, but while this complicates the programming of WINEXT, it does not af-

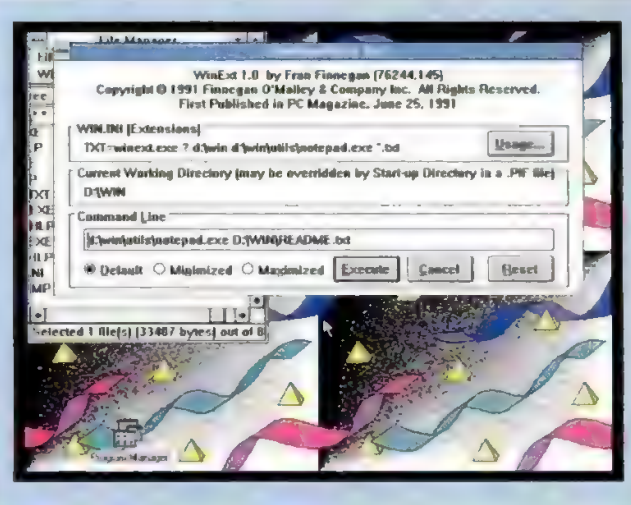

Figure 2: To edit or change commands before they are executed, use the optional ? parameter to bring up this dialog box, which displays the ext= entry, the new current directory, as well as the complete command line.

fect the general description of how WIN .INI [Extensions] information is used.)

USING WINEXT

WINEXT is designed to extend the association power of File Manager, the MS-DOS Executive, and Program Manager. Make sure that WINEXT is on your path. Although you might want to use WINEXT directly from the Program Manager (as a command line represented by a program item icon), it is normally invoked by being included in the entries in the WIN.INI [Extensions] section. The full syntax for WINEXT is

```
ext=winext.exe [?-+] d:\dir
 d:\path\program.ext [arguments]
 ^.ext [arguments]
```

As previously, *ext* is the extension of a data file. The optional ? parameter option causes WINEXT to bring up a dialog box that displays the ext= entry, the new current directory, and the complete command line, as shown in Figure 2. The dialog box gives you a chance to edit or cancel the command before it is executed. This is useful when you are adding or modifying your [Extensions] entries in WIN.INI. Once you are comfortable with how WINEXT operates, you can then simply delete the ? parameter from your ext= lines. Or you can keep it to add arguments at runtime to the command line. The – parameter causes WINEXT to bring up an application minimized, while the + parameter causes WINEXT to bring up an application maximized.

The *d:\dir* section of the syntax specifies the drive and directory in which you wish to be when the program has been started and loaded with its associated data file. Note that the *d:\dir* start-up directory may be . or .. , which will have the effect, respectively, of keeping you in the directory containing the data file or of changing to its parent directory. If you enter an invalid path, WINEXT will warn you in a message box. (Note that .PIF files contain a field named Start-up Directory. *Windows* looks for .PIF files *after* WINEXT asks it to execute an application, with the result that the .PIF file may override WINEXT's specifications, leaving you in a different directory than you intended. If an application that you would like to use in conjunction with WINEXT has a .PIF file, possibly created automatically when you installed *Windows*, be sure that the start-up Directory field in the .PIF file is blank.)

The *d:\path\program.ext* specifies the drive, directory, and name of the program you want to associate with the data file's extension. The *program* can be any DOS or *Windows* executable file or a batch file. (.PIF files have their own way of doing what WINEXT does, so they aren't relevant here.) If *program* does not contain an extension, then .EXE is assumed by *Windows*. If the *program* is not preceded by a drive and/or directory path, *Windows* will search for it in the following order: the current directory (which is now *d:\dir*, since WINEXT switched to it); *Windows* main directory; *Windows* system directory; the directories listed in the PATH environment variable; and the list of directories mapped in a network.

The optional *arguments* parameters (in both places in the syntax) are any arguments peculiar to the application specified that you may want to include. These could be used for compiler switches or compression/decompression utilities, for example. Putting double-quotes around arguments causes a group of arguments to be considered as a single argument; this is the same in DOS.

For the *^.ext* portion of the WINEXT syntax, you can do one of four things. First, you can simply replace the *ext* with the data file extension, as in a normal WIN.INI file (see Figure 1). Because WINEXT has been loaded, however, when you double-click on a file with the associated *ext* in File Manager or the MS-DOS Executive, WINEXT *remembers* the current directory the data file is in, but *switches* to the drive and directory specified by *d:\dir*. Note that if WINEXT does not detect a qualified filespec (one that includes a drive and path), it prefixes the filename with the current directory containing the data file. This assures that all applications started by WINEXT will receive a fully qualified data filename.

Second, for the *^.ext*, you can use the caret alone, with no data file extension specified. This will cause the data file extension to be stripped off. This is useful when dealing with programs (*AutoCAD*, for example) that do not require extensions on the command line or that may indeed not work properly if the data file extension

PC MAGAZINE UTILITIES UPDATES

Like all good software, the programs presented in *PC Magazine* are upgraded and improved. You can get the modified versions by downloading them from PC MagNet. Here's a partial list of the programs that have been upgraded to fix minor bugs and system incompatibilities:

ANSI.COM, Version 1.3
BAT2EXEC.COM, Version 1.3
BCOPY, Version 1.2
BEN56.ARC (Benchmark Series, Version 5.6)
CHKFRAG.EXE, Version 1.2
CMDEDIT.EXE, Version 2.1
CONFIG.CTL, Version 3.0
DIRMATCH.COM, Version 2.0
EMMA.COM, Version 2.2
EMS40.SYS, Version 1.1
LASERLST.COM, Version 1.1
LITES.COM, Version 1.1
LOG.COM, Version 1.1
MONO.COM, Version 1.1
PANDORA.COM, Version 1.5a
PCACCESS.COM, Version 1.1
PCMANAGE.EXE, Version 1.1
PCREMOTE.COM, Version 1.1
RN.COM, Version 2.0
SCHEDULE.COM, Version 1.1
SLICE.COM, Version 1.3
SNIPPER.COM, Version 1.2
TPFST-AT.COM, Version 1.1
ZCOPY.COM, Version 1.2

For a complete list of all the programs available from the PC MagNet Utilities Database, download UDCAT .ARC.

A downloadable index to *PC Magazine*'s product reviews is also available. PCM.EXE is a self-extracting file that contains the *Computer Library PC Magazine* Reviews Index for January 1988 to June 1990. To use PCM.EXE, you need the search files in PCSRCH.EXE. Please read the information file PCM.INF before you download any of these files.

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is present. If you have a particular need, you might even supply an *ext* that is different from your data file's extension. And you can specify ^. to prevent some programs such as Notepad, from automatically appending a program-specific default extension.

Third, you can use * in place of ^.*ext* to tell WINEXT *not* to include any data filename on the command line. This option is particularly useful if you want to use WINEXT as a program item in a program group of Program Manager, as will be shown in the examples below.

Fourth, you can include multiple carets (with or without an extension) in the WIN .INI *ext*= entry. WINEXT will substitute the fully-specified filename (without .*ext*) for each caret, and then add the specific .*ext* from the WIN.INI *ext*= entry that applies to each caret.

Note that in order to use the caret (^) by itself, to add *arguments* after the ^ or ^.*ext*, or to use the asterisk (*) and no filename, you must *manually* edit your WIN.INI file. You can use SYSEDIT, Notepad, or a plain-ASCII text editor. (Remember, too, that you must restart *Windows* in order for the WIN.INI changes to take effect.)

WINEXT also performs case-insensitive environment-variable substitutions when it constructs the new command line from the WIN.INI *ext*= entry; you may be familiar with this concept from writing your own .BAT files. If your WIN.INI *ext*= entry contains an environment variable (you can view them by typing SET at the DOS prompt) enclosed in percent signs, WINEXT will do the appropriate substitution, just as DOS does in .BAT files. Two good examples would be %comspec% and %temp% in a WIN.INI *ext*= string; they might result in the substitution of C:\DOS\COMMAND.COM and C:\TEMP, respectively, depending on your particular configuration. If there is no matching environment variable, WINEXT treats the variable as if it were null or empty, intelligently stripping it out of the *ext*= string.

EXAMPLES IN USE

A few examples may help clarify the WINEXT syntax in actual use. Each of the following assumes that you have placed WINEXT in a directory that's on your PATH so that it can be found without an additional filespec. The best place to put it is in your main *Windows* directory.

I still have an old copy of *Lotus 1-2-3* Release 1A, which must start up in its own directory and which does not accept a .WKS filename as an argument. Since my few remaining .WKS files are scattered all over, I use WINEXT to shift into the D:\123 directory prior to starting *1-2-3:*

```
wks=winext.exe d:\123 123.exe *
```

The * tells WINEXT not to pass a .WKS filename to *1-2-3*, since it can't use it.

Programmers will appreciate the next example. Make files for C applications usually do not have filename extensions, so there isn't a way to put an entry in WIN.INI [Extensions]. But you can put an entry in for the .OBJ extension as follows:

```
obj=winext.exe .  notepad.exe ^.
```

This lets you double-click on an .OBJ file and get the Make file that was used to create it (provided, as is customary, they have the same first eight letters in their filenames). WINEXT will strip off the OBJ before passing the filename to Notepad; the period (.) will not be stripped off, because Notepad would append a .TXT if the period were not there. Some programs require the period by itself appended to the filename to signify a *blank* extension; Notepad is one of those, hence the caret-period (^.). The current working directory would remain unchanged.

I like to keep the directories for specific applications off my PATH environment variable. I also like to have my main applications always start up with the root directory on my D: drive as the current directory. I keep *Excel* in my E:\EXCEL directory, and in addition to using WINEXT within my WIN.INI file, I enter either of the following *Excel* command lines directly in Program Manager to create a Program Item icon:

```
winext.exe d:\ e:\excel\excel.exe *
```

or

```
winext.exe d:\ e:\excel\excel.exe
 d:\path\filename.xlw
```

The first command line starts *Excel* with an empty Sheet1; the second loads a particular WorkSpace. Again, the * tells WINEXT not to pass any filename to *Excel*. (If you use WINEXT as a Program Item in Program Manager, you'll want to change the default icon, which says, "Use File Props to pick an icon." To do this, execute File Properties from Program Manager, choose Change Icon, and enter the filename of the program that you're running with WINEXT.)

I set up *Word for Windows* similarly in Program Manager, but add *Winword*'s /n argument before the * to disable a blank Document1 from appearing:

```
winext.exe d:\
 e:\winword\winword.exe /n *
```

Since I keep most of my data files on D:, this allows me to get into the data directories I choose quickly after starting up *Excel* and *Winword* without having to move to D: from directories on other drives.

As a simple example of substituting environment variables, your DOS Prompt icon in Program Manager might represent a Program Item Properties Command Line that looks as follows:

```
winext.exe d:\  %comspec% /e:512 *
```

This would start COMMAND.COM with an enlarged environment (512 bytes, versus the default of 160) and with the current working directory being D:\ (instead of the usual C:\WINDOWS). If you type SET at a DOS prompt, the first entry in your environment will probably be COMSPEC=C:\DOS\COMMAND.COM or something similar. WINEXT will substitute the C:\DOS\COMMAND.COM for the %comspec% as the program to run, with /e:512 being the only argument, since the * tells WINEXT *not* to insert any filename.

With these examples before you, you'll find it easy to use WINEXT either in your WIN.INI file or from the Program Manager as a Program Item.

PROGRAMMING NOTE

Programmers who download the source code will find that WINEXT belies the idea that *Windows* programs have to be long and complicated in order to accomplish useful things. In fact the program comprises only two C functions. The code is rather short, and it's well-commented. It uses only a few *Windows* API function calls and should be comprehensible to anyone who can read C. ■

Fran Finnegan is a San Francisco–based consultant and author of the Windows column in PC Magazine.

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PC MagNet News

The Latest Files and Features of PC Magazine's On-line Service

Utilities Library Expanded

ZiffNet has had a positive effect on PC MagNet. One new benefit is the expanded Software and Utilities Library (GO SOFTLIB).

Formerly known as the PC Magazine Utilities Database, the library housed only the files and utilities offered through *PC Magazine*. The new Software and Utilities Library has more than doubled in size. The new SoftLib includes many files and macros from our sister publications *PC/Computing* and *PC Week*, the best of quality programs from the Association of Shareware Professionals, as well as all of the shareware and freeware from our own Forum Data Libraries.

Searching for these files has also been made a simpler task. In addition to our usual search methods (by author, magazine name, type of file, filename, or date) you can now search in two new ways to make downloading quicker and more hassle-free—by keyword, or by a special "Latest Files" feature, which houses the most-recently released programs. Now, when you access this search method, you'll find all the files made available from this, the current issue, including the *Windows* utility, WINEXT.EXE.

Of course, the SoftLib will still be chock full of the handy utilities and old favorites such as EMS40.SYS, DR.COM, RN.COM and the latest PC Magazine Labs benchmark tests. You can also find all of the files that have been described in this column over the past few months in the Library.

Largely because of the demand and feedback we receive from PC MagNet users, we have transformed the Software and Utilities Library into one of the most extensive and functional databases of its kind. As the Library continues to grow with each update, it will continue to supply all PC users with the useful files they need.

UnZip Files in Windows 3.0

Like most ordinary *Windows* 3.0 users, I find it a bother to be constantly dropping out to DOS to perform trivial functions that Microsoft hasn't thought to include in its File Manager. One of these distractions is the unzipping of .ZIP archive files. PC MagNet has since located a great little utility, written by first-time author Mickey Coulter, that will help *Windows* 3.0 users avoid the DOS icon.

PC MagNet brings you *WinUnzip*, a simple *Windows* 3.0 utility that can decompress files archived in the .ZIP format. You no longer have to bother with DOS in order to unzip files. WinUnzip allows you to pick a .ZIP file from a list box or to put it on the command line (the utility can be used with programs like *Command Post*, and *Launch*). It unzips the files to your assigned directory and lists the files as they are being decompressed.

The best part of *WinUnzip* is the price. The author has released it as freeware, meaning no registration or update charges. WUNZIP.ZIP is located in UtilForum's DL10 (Windows).—*Chris Parker*

- **ZIFFNET UPDATE: The Software and Utilities Library increases twofold in an effort to provide the ultimate database.**
- **WINUNZIP: This *Windows* 3.0 utility allows you to unzip compressed files without shelling to DOS.**

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by
Charles Petzold

Environments

The Windows 3.0 Device-Independent Bitmap

For personal computers to fulfill their roles as extensions of our minds, they must be able to capture, store, process, and render any type of data used in human communication. An important first step is the full integration of visual information. That's the reason for computer graphics.

In computers, we usually use *bitmaps* to represent real-world images. Consequently, bitmap support has become an important part of graphics programming systems. The introduction of the device-independent bitmap (DIB) was one of the most significant enhancements to the *Microsoft Windows* 3.0 Graphics Device Interface (GDI). It is also one of the most confusing.

A *device-independent* bitmap can be defined as a bitmap with a color scheme that's not necessarily based on the colors available on a particular graphics output device. In contrast, a *device-specific* bitmap is very much tied to a particular output device (usually a video display) and uses only the colors normally available on the device.

Under *Windows* 3.0, the EGA and VGA can display only 16 fixed colors. These colors are black, white, two shades of gray, dark and light versions of the three additive primaries (red, green, and blue) and of the three subtractive primaries (cyan, magenta, and yellow). Even 256-color adapters such as the IBM 8514/A or some Super VGA boards add only 4 more colors to these 16. The other 236 colors can be obtained only through the *Windows* 3.0 palette manager.

These 16 colors have been familiar for years on IBM-compatible hardware, beginning with the CGA running in character mode. Because these colors have become a de facto minimum standard for color displays running under *Windows*, 16-color bitmaps have also become something of a standard. However, the 16 standard colors are not nearly adequate for representing real-world bitmapped images.

The *Windows* 3.0 device-independent bitmap is intended to allow *Windows* programs to work with bitmapped images that have color schemes not necessarily supported by current graphics hardware. However, it is crucial to understand the limitations of what *Windows* is actually providing here. The device-independent bitmap is primarily a file format, as I discussed a couple of issues ago. The file format consists of several blocks of data (an information header, a color table, and the bitmap data itself) that are used in several new GDI function calls.

> ■ The device-independent bitmap is one of the most significant enhancements to the *Windows* 3.0 Graphics Device Interface. It is also one of the most confusing.

Although these new GDI function calls use device-independent bitmap data, GDI does not actually maintain device-independent bitmap objects. This is why the subject of DIBs is confusing. For example, the CreateDIBitmap function sounds like it creates a DIB. It does not, and in this column I'm going to prove it.

THE UNINITIALIZED BITMAP

Like the four bitmap-creation functions I discussed in the last issue, CreateDIBitmap creates a GDI bitmap object. Bitmap objects are stored in memory managed by GDI. A program references a bitmap object by its handle. With the exception of monochrome bitmaps, bitmap objects are always specific to a particular output device.

Like the old CreateBitmap function, the CreateDIBitmap function can create either an uninitialized or initialized bitmap. An uninitialized bitmap has a particular size and color organization, but the image is undefined. It's helpful to examine the two ways you can create a bitmap—uninitialized or initialized—separately.

To create an uninitialized bitmap, you call CreateDIBitmap like this:

```
hbm = CreateDIBitmap (hdc, &bmih,
  0, NULL, NULL, 0) ;
```

This form of the function creates an uninitialized device-specific bitmap compatible with the device context specified by the first parameter. A return value of NULL indicates an error.

The second parameter is a pointer to a structure of the type BITMAPINFOHEADER, as shown in Figure 1. You'll recall that the BITMAPINFOHEADER structure is the second component in a device-independent bitmap file, following the BITMAPFILEHEADER structure.

When calling the CreateDIBitmap function to create an uninitialized bitmap, only the first five fields of the BITMAPINFOHEADER structure are important. You can set the other fields to zero. The **biWidth** and **biHeight** fields specify the width and height of the bitmap in pixels. The **biPlanes** field must be set to 1 and the **biBitCount** field must be set to 1, 4, 8, or 24, indicating the number of color bits per pixel.

It doesn't matter which of the four bit-

THE BITMAPINFOHEADER STRUCTURE

```
typedef struct tagBITMAPINFOHEADER
    {
    DWORD  biSize;            // Size of the structure
    DWORD  biWidth;           // Width in pixels
    DWORD  biHeight;          // Height in pixels
    WORD   biPlanes;          // Set to 1
    WORD   biBitCount;        // Color bits per pixel
    DWORD  biCompression;     // Compression scheme
    DWORD  biSizeImage;       // Number of bitmap bytes
    DWORD  biXPelsPerMeter;   // Horizontal resolution
    DWORD  biYPelsPerMeter;   // Vertical resolution
    DWORD  biClrUsed;         // Number of colors used
    DWORD  biClrImportant;    // Important colors
    }
    BITMAPINFOHEADER ;
```

Figure 1: This structure is the second component in a device-independent bitmap file. It's used in the CreateDIBitmap function.

count values you use! CreateDIBitmap always creates a bitmap compatible with a particular output device—the output device whose device context handle is given as the first parameter. When creating an uninitialized bitmap, CreateDIBitmap is functionally equivalent to the following code:

```
if (bmih.biPlanes == 1 &&
    (bmih.biBitCount == 1 ||
     bmih.biBitCount == 4 ||
     bmih.biBitCount == 8 ||
     bmih.biBitCount == 24))
  {
   hbm = CreateCompatibleBitmap
      (hdc, bmih.biWidth,
       bmih.biHeight) ;
  }
else
     hbm = NULL ;
```

Thus, CreateDIBitmap checks only for valid **biPlanes** and **biBitCount** values and then creates a bitmap compatible with the device whose device context handle is **hdc**.

You're skeptical, I can tell. How can this new, fancy, complex CreateDIBitmap function do the same thing as the old and simple CreateCompatibleBitmap function? Try it out. Try it on a standard 16-color VGA. Create a bitmap using CreateDIBitmap and then use GetObject to examine what you've created. You'll find that the bitmap has four color planes and 1 bit per pixel, regardless of the **biBitCount** value you specify.

Now try it out on a 256-color Super VGA or an 8514/A. You'll find that the bitmap you create has 1 plane and 8 bits per pixel, again regardless of the **biBitCount** value you specify.

If CreateDIBitmap really created a device-independent bitmap, why would it need a device context handle as the first parameter? (And yes, a valid device context handle *is* required. If you set it to NULL, the function will fail.)

You can use a bitmap handle you obtain from CreateDIBitmap the same way you use a bitmap handle obtained from the older bitmap-creation functions. You can mix and match old bitmap functions and new bitmap functions. For example, you can create a bitmap using CreateDIBitmap and use SetBitmapBits and GetBitmapBits with it. Or, you can create a bitmap using the old functions and use SetDIBits and GetDIBits (described shortly) with it.

So why use CreateDIBitmap rather than CreateCompatibleBitmap to create an uninitialized bitmap? There *is* no reason to do so. The standard "use the simplest function for the job" implies that CreateCompatibleBitmap is preferable.

INITIALIZING THE BITMAP

When you create a bitmap using CreateDIBitmap, you can also intialize it with bitmap data. This is an approach you might use when reading a device-independent bitmap file from disk and converting it to a bitmap object. The function looks like this:

```
hbm = CreateDIBitmap (hdc, &bmih,
  CBM_INIT, &bBits, &bmi,
  wColors) ;
```

The first two parameters are the same as described above. The third, CBM_INIT, is a constant that indicates the bitmap is being initialized with bitmap data. The fourth parameter is a pointer to the data itself. (I'll discuss the format shortly.) The last parameter to the function can be either DIB_PAL_COLORS or DIB_RGB_COLORS. Let's ignore DIB_PAL_COLORS for this discussion.

The fifth parameter is a pointer to a BITMAPINFO structure, which is defined in WINDOWS.H as shown in Figure 2. It's basically a BITMAPINFOHEADER structure followed by an array of RGBQUAD values. The array of RGBQUAD structures is the color table of the bitmap. (You'll recall that a device-independent bitmap file contains a color table following the BITMAPINFOHEADER structure, so this is just a convenient way of combining the two blocks of data.) The RGBQUAD structure is defined as shown in Figure 3.

Notice that the BITMAPINFO structure includes just one RGBQUAD structure. If you're creating the bitmap from application-supplied data, you'll need to allocate a chunk of memory large enough for the complete array of RGBQUAD structures. I'll show an example shortly.

You can also set bitmap data into a bitmap after it has been created, by using

THE BITMAPINFO STRUCTURE

```
typedef struct tagBITMAPINFO
    {
    BITMAPINFOHEADER bmiHeader ;
    RGBQUAD          bmiColors[1] ;
    }
    BITMAPINFO ;
```

Figure 2: This structure is used when you want to create an initialized bitmap with CreateDIBitmap.

```
SetDIBits (hdc, hBitmap, nStart,
  nNum, &bBits, &bmi, wColors) ;
```

This function allows you to set the bitmap data on a row-by-row basis. The **nStart** parameter indicates the row (counting from the bottom) where the data begins, and the **nNum** parameter is a count of the number of rows. The last three parameters are the same as those in CreateDIBitmap.

THE BITMAP DATA

The bitmap data supplied to CreateDIBitmap and SetDIBits follows the same format as the bitmap data in a DIB file. The data begins with the bottom row.

Each row must contain a multiple of 4 bytes, possibly padded at the end.

In a monochrome bitmap (1 bit per pixel), the color table has two RGBQUAD structures. The most significant bit of the first byte in each row is the leftmost pixel. A 0 bit represents the first RGB value in the color table and a 1 bit represents the second RGB value.

In a 16-color bitmap (4 bits per pixel), the color table has 16 RGBQUAD structures. The most significant 4 bits of the first byte in each row is the leftmost pixel. The 4-bit pixel values represent an offset into the color table.

THE RGBQUAD STRUCTURE

```
typedef struct tagRGBQUAD
     {
     BYTE rgbBlue ;
     BYTE rgbGreen ;
     BYTE rgbRed ;
     BYTE rgbReserved ; // set to 0
     }
     RGBQUAD ;
```

Figure 3: This structure is used in the color table of the CreateDIBitmap function.

In a 256-color bitmap (8 bits per pixel), the color table has 256 RGBQUAD structures. The first byte in each row is the leftmost pixel. Again, the byte value is an offset into the color table.

In a 24-bit color bitmap, there is no color table. Each pixel is represented by 3 bytes, which can be treated as an RGBTRIPLE structure. (The RGBTRIPLE structure is basically the same as the RGBQUAD structure but without the last field.)

In a 4-bit or 8-bit bitmap, the color table can be truncated. This is indicated by a nonzero **biClrUsed** field in the BITMAPINFOHEADER structure. Also, the bitmap data can be compressed. I'll discuss that in the next issue.

WHAT GDI DOES WITH THIS

The color table and bitmap data you supply to CreateDIBitmap or SetDIBits are device-independent and not necessarily related to colors available on a real output device. For example, you can specify a 256-color bitmap and define the color table so that it contains all possible 256 gray shades between black and white.

However, these two functions will convert the information and data that you supply into a device-specific format that is compatible with the device context whose handle is given as the first parameter to the functions.

Here's what happens: The value of each pixel is an index into the RGB color table (or, in the case of 24-bit bitmaps, an RGB value itself). This RGB color may or may not be available in the current palette on the device. CreateDIBitmap and SetDIBits use the GetNearestColor function (or an equivalent) to find the RGB color closest to the desired color. The pixel value is then altered so that it represents this nearest color in the device-specific format. This is how it is saved in the bitmap object that GDI maintains.

AN EXAMPLE WITH GRAY SHADES

It's time for an example. Figure 4 shows a routine called GrayBit that creates a 16-color 1-row by 16-column bitmap using CreateDIBitmap. The colors of the 16 pixels are specified as gray shades ranging from black on the left to white (or nearly white) on the right.

The function is fairly straightforward. It begins by allocating memory for a BITMAPINFO structure with room enough for 16 RGBQUAD structures. The BITMAPINFOHEADER part of the structure is initialized for a 4-bit (16-color) bitmap with a width of 16 pixels and a height of 1 pixel. The color table is initialized with 16 RGB values for gray shades ranging from 00-00-00 to F0-F0-F0. The bitmap data is an array of 8 bytes. Each pixel requires 4 bits, so the bitmap data contains the color indexes ranging from 0 through F.

CreateDIBitmap creates a device-specific bitmap compatible with the device context whose handle is given as the first parameter. In doing so, the function converts the 16 gray shades to colors that are renderable on the device.

THE RESULTS

Let's run this little function in a *Windows* program on both a 16-color display (such as a VGA) and a 256-color display (such as an 8514/A) and then examine what it does. Because the CreateDIBitmap function creates a device-specific bitmap object and because neither the VGA nor the 8514/A normally renders 16 gray shades under *Windows*, the results are quite different.

As a first step in examining the bitmap object created with CreateDIBitmap, try using GetObject. You first define a structure variable of the type BITMAP:

```
BITMAP bm ;
```

and then call GetObject like this:

```
GetObject (hBitmap, sizeof
  (BITMAP), (LPSTR) &bm) ;
```

The BITMAP structure has several fields that tell you about the bitmap. You'll find these fields set to the following values:

	VGA	8514/A
bmWidth:	16	16
bmHeight:	1	1
bmWidthBytes:	2	16
bmPlanes:	4	1
bmBitsPixel:	1	8

Even though the bitmap was defined as having one color plane with 4 bits per pixel, CreateDIBitmap converted the data into a device-specific bitmap depending on the video display. On the VGA, the resultant bitmap has four color planes with 1 bit per pixel; on the 8514/A it has one plane and 8 bits per pixel.

> The color table and bitmap data you supply to CreateDIBitmap or SetDIBits are not necessarily related to the colors available on a real output device.

The **bmWidthBytes** field indicates the length of each color plane of each row of device-specific bitmap data. The total size of the device-specific bitmap data can be determined by multiplying the **bmHeight**, **bmWidthBytes**, and **bmPlanes** fields. You can then use GetBitmapBits to obtain the device-specific bitmap data.

GetBitmapBits returns the bitmap data in the exact format that it is stored internally in *Windows*. You can verify this for

yourself by running a *Windows* program that creates a hundred such bitmaps under *Windows* Standard Mode. You can then go into the Heap Walker utility supplied with the SDK and take a look at one of the hundred small GDI segments used for storing the bitmaps.

If you call GetBitmapBits for this bitmap created for the VGA, you'll find 8 bytes of data that look like this:

```
07 E3 07 E3 07 E3 00 1F
```

This doesn't look anything like the bitmap data we specified when creating the bitmap. What do these bytes represent?

Well, if you experiment with similar types of routines, you'll find that the device-specific bitmap data for the VGA is stored in four planes in the order red, green, blue, and intensity. For this particular bitmap, there are 2 bytes (16 bits) for each plane corresponding to the 16 pixels. This is clearer if these 8 bytes of bitmap data are shown with the bit values arranged in their respective planes:

```
R:   0000 0111 1110 0011
G:   0000 0111 1110 0011
B:   0000 0111 1110 0011
I:   0000 0000 0001 1111
```

For the first 5 pixels, all the bits are 0, which is black. For the next 6 pixels, the red, green, and blue bits are 1 and the intensity bit is 0. That's dark gray. For the next 3 pixels, the red, green, and blue bits are 0 and the intensity bit is 1. That's light gray. Finally, for the last two pixels, all bits are set to 1 for white.

So you see here that CreateDIBitmap converted the 16 gray shades into colors renderable on the VGA and then converted the data into a device-specific format—a format most suitable for displaying the bitmap on the screen.

If you run the routine under *Windows* using an 8514/A device context, you'll find that the bitmap data is 16 bytes long—1 byte for each pixel. The 16 bytes are

```
00 00 00 00 00 F8 F8 F8
F8 F8 F7 F7 07 08 F6 F6
```

To figure out what these values mean, you can call GetSystemPaletteEntries. The byte values are indexes into that table.

GRAYBIT.C — **COMPLETE LISTING**

```
HBITMAP GrayBit (HDC hdc)
    {
    static BYTE bData[8] = { 0x01, 0x23, 0x45, 0x67,
                             0x89, 0xAB, 0xCD, 0xEF } ;
    BITMAPINFO  *pbmi ;
    HBITMAP     hBitmap ;
    int         i ;

         // Allocate memory for the BITMAPINFO structure

    pbmi = malloc (sizeof (BITMAPINFOHEADER) + 16 * sizeof (RGBQUAD)) ;

    if (pbmi == NULL)
         return NULL ;

         // Initialize it for a 16-color 1-row by 16-column bitmap

    pbmi->bmiHeader.biSize          = sizeof (BITMAPINFOHEADER) ;
    pbmi->bmiHeader.biWidth         = 16 ;
    pbmi->bmiHeader.biHeight        = 1 ;
    pbmi->bmiHeader.biPlanes        = 1 ;
    pbmi->bmiHeader.biBitCount      = 4 ;
    pbmi->bmiHeader.biCompression   = BI_RGB ;  // no compression
    pbmi->bmiHeader.biSizeImage     = 0 ;
    pbmi->bmiHeader.biXPelsPerMeter = 0 ;
    pbmi->bmiHeader.biYPelsPerMeter = 0 ;
    pbmi->bmiHeader.biClrUsed       = 0 ;
    pbmi->bmiHeader.biClrImportant  = 0 ;

         // Initialize the color table for 16 gray shades

    for (i = 0 ; i < 16 ; i++)
         {
         pbmi->bmiColors[i].rgbBlue     = (BYTE) (16 * i) ;
         pbmi->bmiColors[i].rgbGreen    = (BYTE) (16 * i) ;
         pbmi->bmiColors[i].rgbRed      = (BYTE) (16 * i) ;
         pbmi->bmiColors[i].rgbReserved = 0 ;
         }
         // Create the bitmap

    hBitmap = CreateDIBitmap (hdc, &pbmi->bmiHeader, CBM_INIT,
                              bData, pbmi, DIB_RGB_COLORS) ;
         // Clean up

    free (pbmi) ;
    return hBitmap ;
    }
```

Figure 4: The GRAYBIT routine creates a 16-color, 1-row-by-16-column bitmap. It is used to demonstrate what happens behind the scenes with CreateDIBitmap.

The first 5 pixels are the RGB color 00-00-00, or black. The next 5 pixels are 80-80-80, or dark gray. The next 2 pixels (with an index of F7) are the color A0-A4-A0, which is one of the additional four colors in the default 8514/A palette. It's not exactly a gray shade, but it's close. The next pixel is the color C0-C0-C0, light gray, the next is C0-DC-C0, and the last 2 are FF-FB-F0, two more of the extra colors on the 8514/A.

Again, CreateDIBitmap converted the 16 gray shades into the nearest colors renderable on the 8514/A and stored them in a device-specific format.

THE GETDIBITS FUNCTION

Are you convinced yet that GDI is not retaining the original device-independent gray shades specified when calling the CreateDIBitmap function? Or do you think I'm not yet using the correct function to look at this information? Perhaps you're interested to see what happens when you call GetDIBits?

GetDIBits has the same format as SetDIBits:

```
GetDIBits (hdc, hBitmap, nStart,
  nNum, &bBits, &bmi, wColors) ;
```

The **bBits** parameter is an array that receives the bitmap bits. The first five fields of the BITMAPINFOHEADER structure (which is part of the BITMAPINFO structure specified in the fifth parameter) must be initialized before calling the function. GetDIBits will fill in the values of the color table.

What's most interesting about the

GetDIBits function is that the **biBitCount** field of the BITMAPINFOHEADER structure can be set to either 1, 4, 8, or 24. The function will do something appropriate in all four cases. As an example, let's look at what happens when you do this on the VGA.

If you specify 1 bit per pixel, GetDIBits will fill in a color table containing two values: 00-00-00 (black) and FF-FF-FF (white). The bitmap data is 4 bytes (because each row must be a multiple of 4 bytes) but only the first 2 bytes are significant. These bytes are 00 and 1F. Thus, the first 11 pixels are black and the last 5 are black. This is a monochrome approximation to the 16 gray shades.

If you specify 4 bits per pixel, GetDIBits will fill the color table with 16 RGB colors representing the 16 colors available on the VGA. The bitmap data will be

```
00 00 07 77 77 78 88 FF
```

This represents 5 black pixels, 6 dark gray pixels, 3 light gray pixels, and 2 white pixels—exactly what we figured out from the device-specific data.

You can also specify 8 bits per pixel in the BITMAPINFOHEADER structure. You'll get 256 colors in the color table but it's not that meaningful—the first 16 match the VGA colors and all the rest are set to zero. The bitmap data is consistent with the 4-bit data except that each pixel is 1 byte. The values are 5 00 bytes, 6 07 bytes, 3 08 bytes, and 2 0F bytes.

Finally, if you specify 24 bits per pixel, you don't get a color table, but the bitmap data is an array of RGB color values corresponding to black, dark gray, light gray, and white.

WHERE DID IT GO?

You can see that CreateDIBitmap and SetDIBits are very useful in creating bitmaps with customized colors, because you can specify the bitmap data in a device-independent format, and the functions will convert it to a device-specific bitmap. GetDIBits is also very useful, because it converts the device-specific bitmap data back into the device-independent format with a color table.

In contrast, GetBitmapBits and SetBitmapBits work only with device-specific bitmap data with no color table. To use these functions intelligently with color bitmaps, you need to know the internal organization of color planes and color bits on the video display adapter.

But the problem is that with CreateDIBitmap and SetDIBits, what goes into the bitmap is not what comes out. What happened to the device-independent bitmap data we started with? Where did it go? Well, as far as GDI is concerned, it's gone. GDI throws it away. GDI is concerned only with bitmaps that are compatible with real output devices. If you think about this, it makes perfect sense.

The lesson is clear—if your program has access to some device-independent bitmap data (either real-world images from a scanner or frame grabber, or from files in other bitmap formats) and you want to retain this data in a device-independent format, don't rely on GDI to do it for you. What you have to do is maintain device-independent bitmap data yourself in application memory. In the next issue, I'll show you a convenient way to do just this. ■

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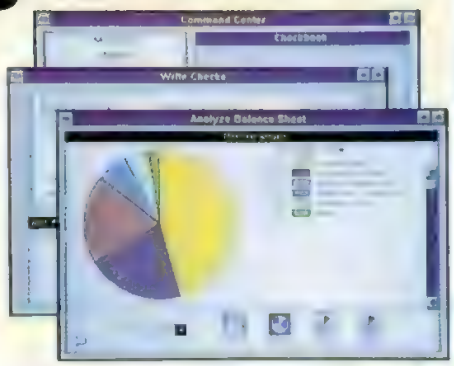

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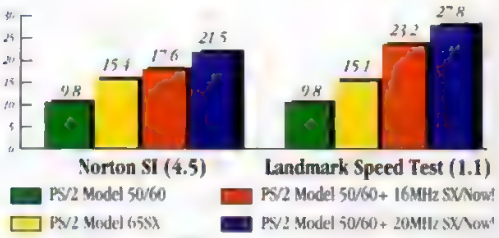

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CIRCLE 106 ON READER SERVICE CARD

by
Fran Finnegan

Windows

&& ORGANIZATION NAMES IN EXCEL 3.0

I recently installed *Excel* 3.0 for *Windows*. Although Microsoft does not use copy protection on *Excel*, it *does* use a "licensed user" form of protection: When *Excel* 3.0 is installed, it asks you to enter your name and your organization's name in a dialog box. This information is subsequently encrypted on the installation disk in the [user] section of EXCEL.INF, a WIN.INI-style file.

Installing *Excel* from the same setup disk on numerous different machines is blatantly illegal. The licensed user procedure affords Microsoft some protection: The perpetrator's name and organization shows up on the start-up "copyright" window of *Excel* each time it runs as well as in the About dialog box of each copy. With such a protection scheme, you get just one chance to enter your name and organization accurately. Once the name is embedded in EXCEL.INF, you won't be asked for it the next time you install *Excel*—unless, of course, you made a backup of your *Excel* Setup disk and can start over from scratch.

To make sure you entered your name and organization correctly, *Excel* immediately displays them in a message box and asks you to confirm that they are correct. If you enter an organization name that contains an ampersand (&), such as Bill Gates & Company Inc., you may be dismayed to see the message box display the name with the ampersand replaced by an underscore (_) and a space removed. The hypothetical company here would appear as Bill Gates _Company Inc.

I immediately recognized why *Excel* would display a company's name this way. When designing menus or dialog boxes, developers insert an ampersand before characters that denote an accelerator key (Alt+<character>). This causes *Windows* to underline those characters. If a developer actually wants to display an ampersand in menus and dialog boxes, he or she must code the string with a double-ampersand (&&). This is the default behavior. You have to deal with the double-ampersand in *Excel* in the File Page Setup dialog box's Headers and Footers as well as in other *Windows* applications. This ability to indicate character underlining with an ampersand also applies to message boxes—like the one used to confirm the entered company name.

- **&& ORGANIZATION NAMES IN EXCEL 3.0:** There are some situations in which the ampersand will not appear as you expect it to.
- **THE IMPORTANCE OF BACKUPS:** Or how to protect the Program Manager from a motivated five-year-old or an inexperienced user.
- **FILE MANAGER RENAME BUG:** Be warned! When you press Enter *before* you type in a new filename in the Rename dialog box, your file *seems* to vanish.

If you're an experienced *Windows* user and you see the ampersand and space replaced with an underscore, you'd probably click on No to the question confirming the company name, back up the program disks, and insert double ampersands. This is what I did with my company's name. The name then appeared correctly with an ampersand, ready for confirmation in the message box. This time, I confidently clicked on Yes.

Well, wouldn't you just know that the resulting copyright window and About dialog boxes then showed our name with double ampersands! It appears that the copyright window and About dialog boxes were *explicitly* coded with a SS_NOPREFIX text style, overriding the default style, which means to *Windows*: *Don't do '&' character translation.* In other words, don't treat an ampersand as indicating underlining, treat it as a regular character. Message boxes *do not* use this SS_NOPREFIX text style, hence the discrepancy. So the confirmation message box is a case of WYSINWYG: What You See Is *Not* What You Get. (If you fix this bug, Microsoft, you should also allow for longer organization names.)

Now our name is forever displayed incorrectly in *Excel* 3.0 and embedded in the original Setup disk in unchangeable encrypted form. So if you have an ampersand in your organization's name and it shows up funny on the confirmation message box, you can ignore it in Version 3.0. But remember to make backup disks beforehand, just in case.

THE IMPORTANCE OF BACKUPS

After installing *Windows* 3.0 and its graphical environment on my 80286-based home computer, my five-year-old son was able to explore educational and leisure applications without constant supervision—as was required with the command line of DOS. By setting up both *Windows* and non-*Windows* applications under *Windows* 3.0 and demonstrating the use of the mouse and icons and the mechanics of basic *Windows* tasks (such as opening, saving, and closing files) my five-year-old quickly became *Windows* 3.0-literate. My wife and I were amazed at how little assistance was required for our son to load and use the various programs through *Windows*.

However, one problem did arise. I began to find that various Program Manager group files were being deleted or damaged. I figured this was because my boy has not yet mastered reading and must have selected File Delete while pulling down a menu. When the problem persisted, I sat through a couple of his *Windows* sessions. The deletion of group files appeared to be

random, which did not make sense to me until I actually observed the problem. My son was not deleting the group files at all, but was instead powering down the system before it had returned to DOS. When exiting *Windows*, all Program Manager changes are saved in the PROGMAN.INI and .GRP files. It was at this point that the group files were being damaged or deleted. On my 80286, *Windows* takes quite some time to shut down properly. Since my son was powering down during the middle of the point at which the files were being rewritten, some stuff was lost. Now that I have instructed him to not power down the system until the DOS prompt has returned, the problem has not recurred.

> When exiting *Windows*, all Program Manager changes are saved in the PROGMAN.INI and .GRP files. If you power down before *Windows* has finished saving all these files, you might damage or even delete them.

Joseph Lischinsky
Beverly, Massachusetts

The loss of PROGMAN.INI and .GRP files has been a common complaint among *Windows* users, both in letters I've received and on PC MagNet and bulletin boards. The common thread seems to be, Why does this happen, and, What can I do to prevent it from happening again?

Answering the *why* part is difficult. Two obvious answers would be powering down too early, as Lischinsky's son was doing, and not having enough free disk space at the time Program Manager needs to save everything. Beyond that, one could only speculate that there are bugs in Program Manager. (One known bug involves opening more than nine groups when in Real mode; at least one group won't open.)

As to preventing the problem, the answer is simple: Keep backups of all your .INI and .GRP files. SysEdit uses the .SYD filename extension for SYSTEM.INI and WIN.INI backups. I use the same extension for *all* my backed-up .INI files. I use the .BAK extension for my Program Manager group files so that there will be no conflicts with any .INI files that may have the same filename. I also put all of my *Windows* file backups in a subdirectory under C:\WINDOWS, for further protection. Periodically I just type

```
copy *.ini bak\*.syd
copy *.grp bak\*.bak
```

Contributing editor Barry Simon names his backups of these files with .INK and .GRK extensions, but keeps them in his *Windows* directory. It doesn't really matter where the backups are kept and what their extensions are. The important thing is that you do backup these critical *Windows* files periodically. Right now is a good time to start; it doesn't take more than a minute.

FILE MANAGER RENAME BUG

I recently discovered a seemingly dangerous "bug" in the File Manager of *Windows* 3.0. While renaming a file using the File Rename command, I accidentally hit Enter before typing the new filename into the dialog box. The file I was trying to rename just disappeared from the file listing! Even the tech support at Microsoft did not know how to get it "back."

After some experimenting, I discovered that the File Manager did not actually *delete* the file, but rather *renamed* it to the name of the subdirectory where the file resided. Suppose you're in a subdirectory named REPORTS and you try to rename a file called SALES.DOC. If you accidentally hit the Enter key before you type in a name, a file named REPORTS will appear in the subdirectory.

I just wanted to save other *Windows* users the frustration of thinking they've lost files.

Grant Johnson
Fair Oaks, California

I would definitely call this a bug, because I can't think of any reason why a user would want File Manager to work this way. Dialog boxes are supposed to be coded in such a way that meaningless or erroneous actions are ignored. This is usually done by disabling buttons (in other words, turning them gray). Dialog boxes are also supposed to ignore the Enter key if it has no meaning at the time it's hit. For example, look at Notepad's File Save As dialog box. It disables the OK button and ignores the Enter key until you begin entering a filename. File Manager should operate the same way—and maybe someday it will.

But until Microsoft comes up with a solution to the problem, you can protect yourself in a rather crude way. Just go into each of the subdirectories that you work in frequently, and enter the following line at the DOS prompt:

```
rem >dirname
```

where *dirname* is the name (without any path information) of the subdirectory you're currently in. **rem** is a do-nothing command, but the DOS redirection symbol (>) will cause DOS to record the directory name as a file. Continuing Johnson's example, you would type

```
rem >reports
```

This command creates a 0-length file (no disk space is wasted) and puts the filename entry—REPORTS—into the subdirectory. After doing this, you won't accidentally "lose" files with File Manager, since it cannot rename the file to a name that already exists. The File Manager still tries, but it encounters a "file" already named REPORTS (or whatever), and it displays a message box saying that the file already exists. At this point, you would choose Cancel.

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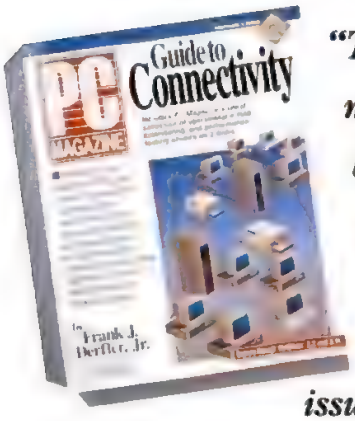

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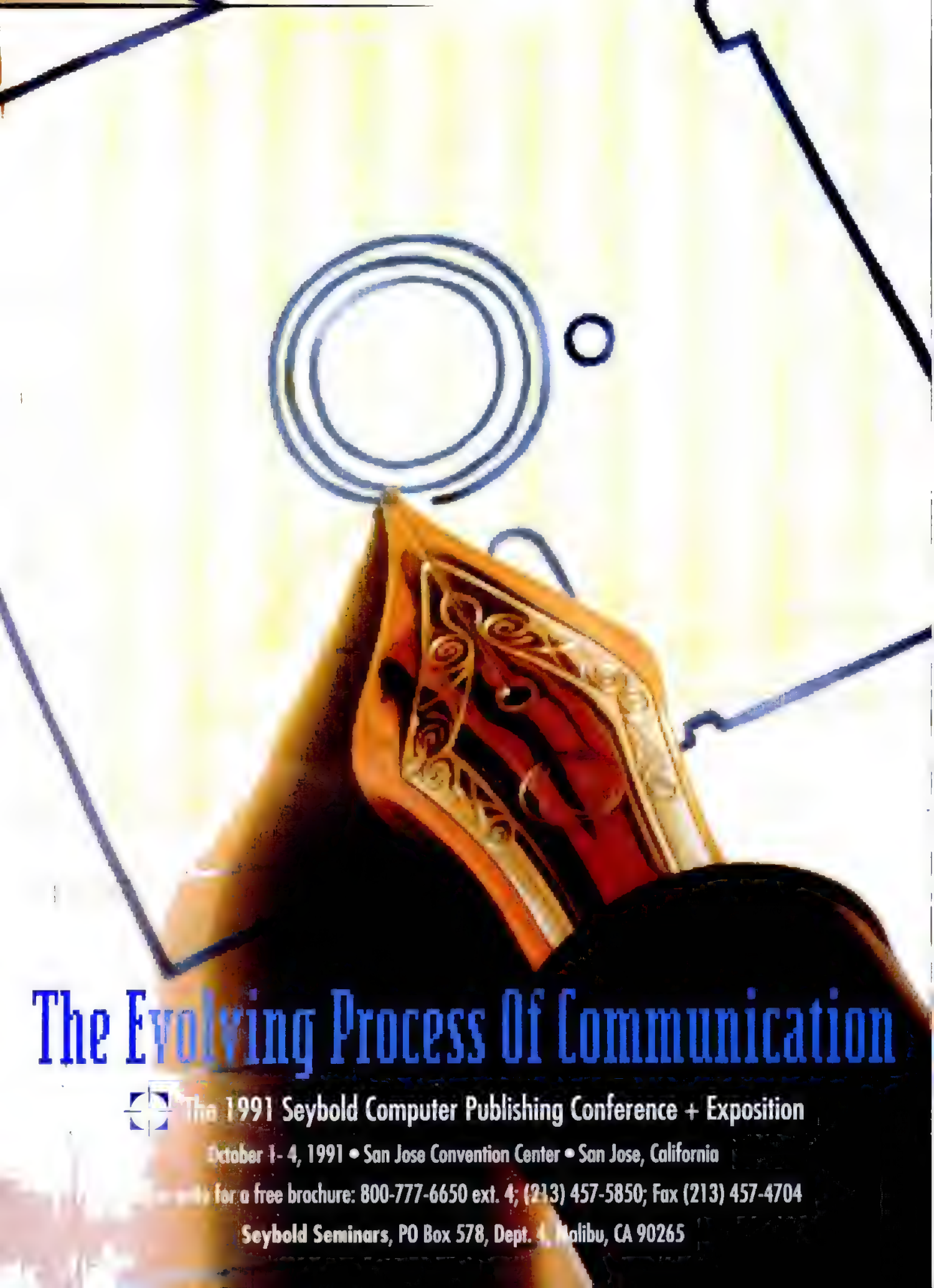
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by
Sal Ricciardi

Databases

QUARTERLY RESULTS

Several times I have had to summarize data by the quarter of the year. I created a technique (shown in Figure 1) with two handy one-liners to compute the quarter of the year, given the month, and to compute a suffix for the quarter number.

The first one-liner computes the quarter. You can use this technique regardless of how your fiscal calendar is set up. (Some fiscal years, for example, start with October 1.) The string "111222333444" used in the example represents the distribution of the four quarters across the 12 months, assuming that the fiscal year begins January 1. If your fiscal year begins on October 1, change this string to "222333444111". If the fiscal year begins July 1, use "333444111222".

The second one-liner computes a suffix for your quarter number. For example, if QTR is 1, it will return "st". If QTR is two, it will return "nd".

Raymond E. Richard
Middleburg, Florida

- **QUARTERLY RESULTS:** Place a month in the right quarter regardless of the fiscal calendar.
- **USING THE STANDARD TIME FORMAT:** This function lets you convert military time into A.M./P.M. format.
- **CUSTOM START-UP DISPLAYS:** Here's a simple way to customize your start-up display using *dBASE IV* Runtime.

Placing a month in the quarter where it belongs (and taking the fiscal calendar into account) is a common requirement for financial reporting. If your applications require divvying up data by quarter, you'll undoubtedly find these two techniques handy.

If you use *Clipper*, *FoxPro*, or *dBASE IV*, you can place the two in UDFs using a passed parameter for the quarter arrangement, as follows:

```
FUNCTION QtrNum
PARAMETER Month, QtrArr
RETURN SUBSTR(QtrArr,Month,1)

FUNCTION QtrStr
PARAMETER Month, QtrArr
PRIVATE Qtr
Qtr = SUBSTR(QtrArr,Month,1)
RETURN Qtr + ;
 SUBSTR("--st-nd-rd-th", ;
 VAL(Qtr)*3,2)
```

You might try it like this:

```
.QtrArr = ''111222333444''
.? QtrNum(7,QtrArr)
3
.? QtrStr(7,QtrArr)
3rd
```

HOW TO COMPUTE THE QUARTER NUMBER

```
* Technique to compute any quarter of year based on input from user.
* Adjust the string of numbers to fit quarter arrangement.  Replace
* QTR or MNTH with your field name. The variable QTR is returned as
* string data.  If a numeric variable is needed use: VAL(qtr)
* or use the system date as in the following:
* qtr = VAL(SUBSTR("111222333444",MONTH(DATE()),1)

* dBASE III Plus tested.
SET TALK OFF
CLEAR
mnth = 0
@ 10,10 SAY "Enter month to translate: " GET mnth RANGE 1,12
READ

* Here is one-liner number 1
qtr = SUBSTR("111222333444",mnth,1)

* Here is one-liner number 2
qtrsufx = SUBSTR("--st-nd-rd-th",VAL(qtr)*3,2)

* Here is the results
@ 12,10 SAY "Month "+ LTRIM(STR(mnth))+" is the " + qtr + qtrsufx +;
" quarter."

RELEASE mnth, qtr, qtrsufx
SET TALK ON
RETURN
```

Figure 1: This program demonstrates a short and handy technique for placing a month in the quarter it belongs, depending on the fiscal calendar.

USING THE STANDARD TIME FORMAT

I often need to include the time on my printed *dBASE IV* reports, but the TIME() function uses the military 24-hour format. The procedure shown in Figure 2 can be used to convert the results returned by TIME() into standard format with A.M. and P.M. designators.

John H. Nixon, Jr.
Cove Birmingham, Alabama

Changing the TIME() function's military format into the A.M./P.M. format that we're all more familiar with is a common requirement. The routine shown in Figure 2 is actually a modified version of the one Nixon submitted. It relies on the IIF function and some knowledge about the way the VAL function works to create a shorter procedure.

THE STIME FUNCTION

```
FUNCTION stime
PARAMETER t
RETURN IIF(VAL(t)<12, t + " Am", ;
         IIF(VAL(t)=12, t + " Pm", ;
           STR(VAL(t)-12,2) + SUBSTR(t,3) + " Pm"))
```

Figure 2: The STIME function converts military time into standard A.M./P.M. format.

The VAL function, which converts a character string to a numeric value, stops converting as soon as it reaches a nonnumeric in the input string. So, if the **t** variable contains "23:59", **VAL(t)** returns 23, because it stops converting when it reaches the colon. That's why the STIME function in Figure 2 can get away with using **VAL(t)** instead of using **VAL(SUBSTR(t,1,2))**.

The IIF (immediate IF) function accepts three expressions as parameters. If the first expression evaluates as true, then the result of the second expression is returned. Otherwise, the result of the third expression is returned. In the STIME function, the third expression is actually another IIF, demonstrating that you can nest IIFs.

CUSTOM START-UP DISPLAYS

The *dBASE IV* Developer's Edition includes a Runtime module so that application developers can create and distribute *dBASE* applications without requiring end users to own a copy of *dBASE IV*. However, the Runtime module automatically displays Ashton-Tate's license agreement at start-up. Thus, if a developer wants to include a custom license agreement/copyright notice in an application, the user will be presented with two agreements, Ashton-Tate's and the custom one.

You can suppress the initial license agreement display by using the undocumented command-line switch, /T. However, in some versions of *dBASE IV*, this switch does not suppress all of the initial start-up display messages. I have developed a technique to use (in addition to /T) that overcomes this limitation. It works because the CONFIG.DB file is read before the start-up agreement is displayed.

In the CONFIG.DB file, I change the screen foreground and background colors to the same color so that the notices cannot be seen even though they're still being displayed. Inside the main application program, I then reset the colors to reenable the display and then display my custom copyright notice or license agreement in a window.

One side-effect can occur when using this technique. If there is an error while the CONFIG.DB file loads, you won't see the error message (because of the color settings), and the program will pause. Therefore, this technique is best used with a fully debugged CONFIG.DB file.

The CONFIG.DB and SAMPLE.PRG programs that are shown in Figure 3 illustrate this technique. The command to run the sample program using the *dBASE IV* Runtime is:

```
RUNTIME /T SAMPLE
```

Michael D. Murphy
Ottawa, Ontario
Canada

CONFIG.DB AND SAMPLE .PRG — COMPLETE LISTINGS

```
* CONFIG.DB
COLOR        = B/B                    && Blue on Blue
COLOR OF BOX = B/B                    && Blue on Blue

TALK         = OFF
STATUS       = OFF
DISPLAY      = EGA25
COMMAND      = DO SAMPLE.PRG


* SAMPLE.PRG
* Sample program for resetting the screen colors
* and displaying a custom copyright notice

* Set up environment
CLEAR ALL
SET SCOREBOARD  off
SET ESCAPE      on
SET CLOCK       off
SET COLOR OF BOX    TO R/BG     && Red on Cyan
SET COLOR OF NORMAL TO GR+/B    && Yellow on Blue

* Define copyright window
DEFINE WINDOW copyright FROM 8,10 TO 14,70

* Display window and copyright notice inside
ACTIVATE WINDOW copyright
   @ 1,21 SAY "Sample Application"
   @ 3,13 SAY "Copyright (c) XYZ Corporation 1991"
   delay = INKEY(5)             && Delay for five seconds
   RELEASE delay
DEACTIVATE WINDOW copyright
RELEASE WINDOW copyright
*
* Remainder of Main Procedure Code
*
QUIT
```

Figure 3: CONFIG.DB and SAMPLE.PRG illustrate how to create a custom start-up display for a copyright notice or license agreement using the *dBASE IV* Runtime.

It's annoying to have to view the license agreement/copyright screens, especially in a custom application. The undocumented /T switch is a step in the right direction, but Murphy's technique is more complete.

When you set the foreground and background colors to the same color, anything that is written to the screen will be invisible until the colors are reset in the main program. This allows you to suppress the Ashton-Tate start-up messages while providing a custom initial sign-on display that can contain any information you like.

LET US HEAR FROM YOU

Share your database experience, tips, and techniques; we'll pay you $50 for any tip we print. Submissions can be mailed to our office or uploaded to PC MagNet. Mailed submissions must be made on-disk, accompanied by a printout, and sent to Databases, One Park Avenue, New York, NY 10016. To upload your contribution to PC MagNet, see page 8 for access instructions. You may also contact Sal Ricciardi directly via his CompuServe ID number: 72241,33. ■

by
Craig Stinson

Spreadsheets

1-2-3-TO-EXCEL TRANSITION

Ever since moving from *Lotus 1-2-3* to *Microsoft Excel*, I have sorely missed *1-2-3*'s ability to copy a formula down a column next to a long range of already filled cells. To accomplish this task, *1-2-3* used the following technique:

```
/Copy {Enter} {Down} . {Left}
 {End} {Down} {Right} {Enter}
```

and in *Excel*, I can find no command or feature to duplicate it. After calling Microsoft (no joy) and trying a macro (cumbersome), I came up with a painfully simple method that exemplifies the merit of nonlinear thinking. The procedure

```
/Edit Copy {Left} {Ctrl-Down}
 {Right} {Shift-Ctrl-Up} {Enter}
```

is just like the *1-2-3* technique, and it takes fewer keystrokes!

Karl Buhr
Atlanta, Georgia

PC MAGAZINE Buhr is referring to the widely practiced "hitch a ride" technique for making a COPY TO range match the extent of an adjacent column. In *1-2-3*, for example, if column A is filled from A1 to A100 and you want to copy B1 into B1..B100, you can start at B1, press /C, press the Period key, move to column A, and then use End-Down to get straight to A100. At this point, your COPY TO range is B1..A100, so you can finish the job by pressing the Right key once and hitting Enter.

As Buhr has discovered, *Excel* provides an equivalent (if perhaps less obvious) technique for accomplishing this kind of copy. Two points in his tip should be of particular interest to *Excel* users with ingrained *1-2-3* keyboard habits: First, you can get to *Excel*'s menus by pressing / (as well as by pressing Alt or F10). This is true whether or not you have used the Options Workspace command and selected the Alternate Navigation Keystrokes check box. Second, when you're copying a cell or range, the Enter key acts as a keyboard shortcut for the Edit Paste command. This shortcut is not listed on the Edit menu, and you'll have to dig to find mention of it in the documentation. However, engraving the trick in your muscle memory will help you do routine chores more quickly in *Excel*.

- 1-2-3-TO-EXCEL TRANSITION: Here's an easy way to make a COPY TO range in *Excel* match the extent of an adjacent column.
- AUTOMATIC FILE SAVE IN 1-2-3: A short macro periodically backs up your worksheet while you work.
- EXCEL 3.0—A DRAWING PACKAGE?: Reduce the row height and column width to a fine grid and you have a program to rival *Windows* Paintbrush.

AUTOMATIC FILE SAVE IN 1-2-3

All too often, I've been caught forgetting to save a *1-2-3*, Release 2.2, spreadsheet after I've updated it. Other times, I've accidentally deleted an essential column or row. Since my system's memory is limited, I can't afford to enable Undo. I've then had to quit without saving in order to restore the vital data. To deal with these situations, I've developed the autosave macro shown in Figure 1. The macro counts ten carriage returns, then saves the current file under the name BACKUP. The previous version of BACKUP, if any, is backed up in the process.

This macro has one drawback: While it's running, I can't run any other macros. It *has*, however, saved the day many times!

Dana L. Bell
Pittsburgh, Pennsylvania

PC MAGAZINE The inability to use other macros while the backup macro is running doesn't have to cramp your style. Simply press Ctrl-Break if you need to run a different macro. *1-2-3* will stop processing the backup loop and let you run your other macro. To reinstate the autosaver, press Alt-B again.

Bell's macro has one other hazard, though: it assumes your system is in READY mode after the tenth Return character. If your tenth Return happens to fall in the middle of a command (such as /File Save or /Data Fill), *1-2-3* will beep, the command will fail, your worksheet won't be backed up, and parts of the word BACKUP will be splattered all over the current cell—not a pretty sight!

Release 3.*x* users can eliminate this hazard with the help of the @INFO function, as shown in Figure 2. @INFO, introduced with Release 3.0, returns various kinds of information about the current state of the system in which it's run—the amount of memory available, the name of the operating system, the current directory, the number of files in memory, and so on. Like @CELLPOINTER, it takes a single text argument enclosed in

FILESAVE.WK1 COMPLETE LISTING

```
    A          B
1   \B         {?}~{?}~{?}~{?}~{?}~
2              {?}~{?}~{?}~{?}~{?}~
3              {paneloff}/fsBACKUP~B{esc}
4              {panelon}{branch \B}
```

Figure 1: Forgetting to save updated worksheets? This macro saves all your changes to a backup file after you've pressed enter ten times. It continues to update the backup every ten Enters thereafter. The macro works only if the system is in READY mode after the tenth return.

quotes; the argument determines the type of information returned. @INFO("mode") returns the current mode; if the system is in READY mode, @INFO("mode")=1.

The variation on Bell's macro shown in Figure 2 waits for ten Return characters, then checks the mode. If *1-2-3* is in READY mode, the macro proceeds to the backup routine; otherwise, it loops back to count ten more Returns.

Unfortunately, this won't work in Release 2.2. Figure 3 shows a less elegant but still effective solution for Release 2.2 users. To ensure that you don't try to back up your file while in the middle of another command, this variation simply hits the Esc key eight times before performing the backup. If you're already in READY mode, no harm is done; if not, the eight escapes should get you there.

I need to point out one other consideration about Bell's backup system. While you're working and the macro is doing its periodic saves, *1-2-3* will consider the name of your file to be BACKUP.WK1—regardless of what name it had at the beginning of your session. When you're ready to quit or to retrieve a new file, be sure to give your file back its real name! Otherwise, the next time you use this macro with a different file, the worksheet you took pains to preserve will be history.

FILESAV2.WK3 COMPLETE LISTING

```
    A          B
1   \B         {?}~{?}~{?}~{?}~{?}~
2              {?}~{?}~{?}~{?}~{?}~
3              {if @info("mode")=1}{BACK}
4              {branch \B}
5
6   BACK       {paneloff}/fsBACKUP~B{esc}
7              /fsBACKUP~B{esc}
8              {panelon}
```

Figure 2: This Release 3.*x* version of FILESAVE uses the @INFO function to determine whether the system is in READY mode. If it's not, the macro loops back to the beginning.

FILESAV3.WK1 COMPLETE LISTING

```
    A          B
1   B          {?}~{?}~{?}~{?}~{?}~
2              {?}~{?}~{?}~{?}~{?}~
3              {paneloff}{esc 8}/fsBACKUP~B{esc}
4              {panelon}{branch \B}
```

Figure 3: This version of FILESAVE ensures users of Release 2.2 that the system is in READY mode after the tenth return press.

EXCEL 3.0—A DRAWING PACKAGE?

I've discovered a simple trick that turns *Excel* 3.0 into a decent drawing package—much more powerful than the *Windows* Paintbrush program. Simply set *Excel*'s column width to .92 and row height to 6.5. The result is a regular alignment grid—the kind you would get with a dedicated drawing package, such as *Charisma*. By using the Ctrl key in conjunction with *Excel*'s drawing tools, I can create great business flow charts, matrices, organization charts, and so on. If I need to add freehand drawing, I can paste it in from Paintbrush.

In addition to the alignment grid, *Excel* offers several advantages over Paintbrush, such as treating text blocks as objects, having text aligned automatically, adding arrows by choosing menu commands, all kinds of shading and patterning options, and a print previewer! These features add up to the difference between sloppy drawings and smart business charts.

Emmanuel Sebag
Pittsburgh, Pennsylvania

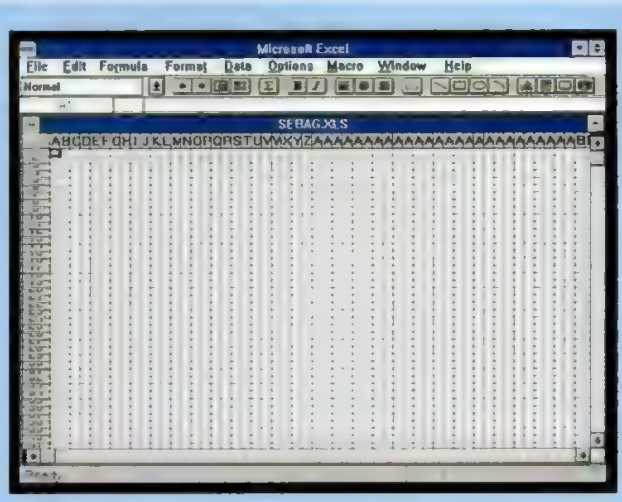

Figure 4: Turn *Excel* 3.0 into a drawing tool. Just set the row height and column width to a fine grid. Then, as you create shapes, hold down the Ctrl key to align the images with cell boundaries. You can also treat text blocks as objects and make extensive use of shading and patterns.

If you hold down the Ctrl key while creating rectangles, ellipses, or lines using *Excel*'s drawing tools, *Excel* forces the graphic objects to align with cell boundaries. By setting your column widths and row heights as Sebag advises, you can create a rather fine alignment grid, with the horizontal and vertical lines appearing at even intervals (see Figure 4). For a coarser, but still "square" grid, double the row heights and column widths to 1.84 and 13, respectively.

After you've set up the grid, you might want to use the Options Display command to turn off the display of grid lines and headings. You won't need the headings, because (presumably) you're not going to be entering ordinary spreadsheet data, and the alignment feature works whether the grid lines are displayed or not.

If you're going to be using an alignment grid more than once, consider saving it as a template file. To do this, choose the File Save command and click the Options button. Select Template in the file-type list box, click OK, supply a filename, and click OK again. Now, whenever you want to create a diagram or other graphic display, you can simply load the template file. *Excel* will present you with a copy of the template you saved, leaving the original intact on-disk. If you use the template frequently, store it in a subdirectory named XLSTART immediately subordinate to your *Excel* program directory. Then you'll be able to select the grid template by choosing the File New command; its name will appear in a list box alongside the standard Worksheet, Chart, and Macro Sheet file types.

HINTS, TIPS, QUESTIONS

Share your latest spreadsheet discovery through *PC Magazine*'s Spreadsheets column. We'll pay you $50 for any tip we print. Please submit your letter on a disk, together with a printout. Mail your contribution to Spreadsheets, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 8 for access instructions). ■

by
Costa Rodis

The Working Word

RESETTING PRINTER DEFAULTS IN WORD 5.5

While I'm generally happy with my upgrade to *Microsoft Word* 5.5, this latest version has disabled one of my commonly used macros. That macro, which I called Printer Reset, reestablishes the default settings in the printer options window.

In the latest version of *Word*, you can't reset certain options—in particular, the number of copies—without printing something. Thus you have to check the option panel before each printing task, rather than adjusting the panel any time you want. The trick, it turns out, is to reset the options and print to a file, because *Word* 5.5 always defaults back to printing to a printer after any print job.

Terry Abraham
Moscow, Idaho

Several options, such as the printer name, graphics resolution, and printer port, can be changed permanently through *Word*'s Printer Setup. But the only way to change the Page Range and the number of copies to be printed is to actually print a document. And Abraham is exactly right: You can work around the limitations by printing to file. But if your default settings are always the same, there's no reason you can't do the work more quickly with a macro, such as PrinterReset (shown in Figure 1).

The PrinterReset macro, which deals with the most basic settings, ensures that you have the print setup you usually need when you're ready to print. In a nutshell, the macro opens the Print window, sets the number of copies to 1, sets Page Range to all, deletes specific page numbers, and selects the HP LaserJet. For different settings, you'll have to adjust the macro. You can also add options to the macro such as the port, graphics resolution, directories, whether or not to skip downloading fonts, draft or duplex printing, and whether or not to print the summary info and hidden text. All it takes is adding the appropriate keystrokes.

- **RESETTING PRINTER DEFAULTS IN WORD 5.5:** The latest version of *Microsoft Word* won't let you reset a few of the print options unless you actually print something. Here's a macro that skirts the limitation.
- **CLEANER SUPER- AND SUBSCRIPTS:** Get rid of awkward gaps between lines with a few changes to *Word for Windows'* superscript and subscript macros.

The macro language of *Word* 5.5 is identical to that of Version 5.0. The thing to keep in mind is that calls to the menu must reflect the nomenclature of the new interface. For example, instead of pressing Esc, P to get to the print screen, you'd press Alt-F, P. If you've been using *Word for Windows*, you should find the menu structure rather familiar, although the overall interface may seem a touch awkward. Users of *Word* 5.0 may feel that Version 5.5 is either quite slick, or they may find it's just plain frustrating. After learning *Word*'s Byzantine menu system, this new setup might seem like betrayal.

If you create the macro from Figure 1, pull down the macro menu, choose Record, type out the macro name, if you like, select a shortcut key combination, and tap Enter. Following the listing, *press* the keys within the brackets (<>) and *type* the characters outside of the brackets. That is, record <alt f>p by holding Alt and tapping F, then hitting the letter P. Continue in this way with each line. When done, press Alt-M (the mouse will not work in menus while a macro is being recorded) and select Stop Recorder.

If you'd rather just type or copy in the text of the macro, choose Macro Stop Recorder (Alt-M, C) right after entering

PRINTERRESET — COMPLETE LISTING

```
«message Printer Defaults Reset!»
«COMMENT Print message at bottom of screen»
«set echo = "OFF"»
«COMMENT Do not echo following commands to the screen»
<alt f>p
«COMMENT Open File menu and open Print options window»
<alt c>1
«COMMENT Move cursor to number of Copies and type 1»
<alt a>
«COMMENT Set all pages of document to print»
<alt s><del>
«COMMENT Delete any specific page numbers previously chosen to
print»
<alt r>hplaser
«COMMENT Open Printer Setup window and type out printer
definition»
<alt e>continuous<enter>
«COMMENT Set paper feed to continuous and exit Printer Setup
window»
<alt f>testprnt<enter>
«COMMENT Choose to print document to File with name of TESTPRNT
and overwrite existing file of same name»
<enter>
«COMMENT Print/return to document window»
```

Figure 1: A macro makes it faster to load the *Microsoft Word* print settings you want as defaults.

the macro name and shortcut key. Return to the Macro menu and choose Edit. Select the macro name and choose Edit again. Type the text of the macro exactly as you see it here. To create the chevrons that surround the comments, hold down Ctrl and tap [or]. When you're done, select the text and delete or copy it (Alt-E, C). Choose Macro Edit Define and answer yes to replacing the macro. Close the macro edit window to return to your document. Delete any macro text left in the document.

To use the macro, choose Macro Run or press the shortcut key you defined. Now, whatever you print will use the defaults you've chosen.

CLEANER SUPER- AND SUBSCRIPTS

Using *Word for Windows* subscripts or superscripts increases the space between lines, causing gaps that look unprofessional. But the line spacing can be maintained using the superscript and subscript macros listed in Figures 2 and 3. In fact, I've replaced the code in the global macros with that of the modified ones. My macros shrink the size of selected text by 2 points. They also reduce the superscript height to 2 points above and the subscript depth to 1.5 points below the baseline. If the selected text is already super- or subscripts, they return to the default point size and baseline.

The icons on the *Word for Windows* Ribbon call the built-in command level. In other words, the + and = icons give you uneditable defaults for superscript and subscript. Thus you can't use these icons as a shortcut to the new macros.

R. Shaw
Givrins, Switzerland

You can see the difference right away if you create a test document where one line includes the macro super- and subscripts and another uses the super- and subscripts selected from the Ribbon. The text selected with the buttons remains the same point size as the surrounding text and is raised or lowered a half line. Shaw's macros give a document a trimmer, neater look, since the super- and subscripts are smaller than preceding and following text. Furthermore, next to the built-in macros the modified ones produce characters that do not rise as far above or drop as far below the baseline. This means that superscripts are barely raised above the tallest character and subscripts do not drop much below the lowest descender of a character.

If you download the macro from PC MagNet, you can import it into a *Word for Windows* macro easily. Use Insert File to bring it into a *Word for Windows* document screen; be sure to choose Text file format. Select the text and choose Edit, Cut. Now check the menu bar at the top of the screen. If Macro does not appear, click on View and select Full Menus. Macro will show up immediately to the left of Window. Open the macro edit window (Macro, Edit) and select the macro—Superscript or Subscript—from the list. Delete the existing code and Paste in the revised macro code.

If you're typing in the macro, enter the code exactly as you see it here. You can skip any REM line—a remark about the preceding line of code. Any remarks you add must be preceded by either REM or an apostrophe.

SUBSCRIPT — COMPLETE LISTING

```
Sub MAIN
REM     All macros must begin with Sub MAIN.
FormatDefineStyles StyleName$()
REM     Define a new style based on the current style.
Dim dlg As FormatDefineStylesChar
REM     Set the variable "dlg" as the current character style.
GetCurValues dlg
REM     Store the current values of "dlg" in DialogRecord.
If SubScript() Then
REM     If SubScript is on, then...
FormatCharacter .Points = dlg.Points, .Position = $
REM     Format the currently selected text to be set as defined
REM     in "dlg".
Else
REM     Otherwise...
FormatCharacter .Points = Val(dlg.Points) - 2, .Position = "-1.5pt"
REM     Format the currently selected text to be two points
REM     smaller than as defined in "dlg" and positioned 1.5 points
REM     below the current baseline.
End If
End Sub
```

Figure 3: The super- and subscript macros shown here and in Figure 2 avoid the line-spacing gaps created by the *Word for Windows* global macros.

SUPERSCRIPT — COMPLETE LISTING

```
Sub MAIN
FormatDefineStyles StyleName$()
REM     Define a new style based on the current style.
Dim dlg As FormatDefineStylesChar
REM     Set the variable "dlg" as the current character style.
GetCurValues dlg
REM     Store the current values of "dlg" in DialogRecord.
If SuperScript() Then
REM     If SuperScript is on, then...
FormatCharacter .Points = dlg.Points, .Position = $
REM     Format the current selected text to be set as defined
REM     in "dlg".
Else
REM     Otherwise...
FormatCharacter .Points = Val(dlg.Points) - 2, .Position = "2pt"
REM     Format the currently selected text to be two points smaller
REM     than as defined in "dlg" and positioned 2 points above the
REM     current baseline.
End If
End Sub
```

Figure 2: Produce superscript that's more presentable than that created by the *Word for Windows* built-in macro. A subscript counterpart is shown in Figure 3.

TIPS FROM WORKING WORDSMITHS

Tell the Working Word your latest word processing discovery; we'll pay you $50 for any tip we print. Please send your contribution on-disk along with a printout to The Working Word, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 8 for access instructions). ■

by
Neil J. Rubenking

User-to-User

CHANGING DIRECTORIES

2.BAT (shown in Figure 1) is a neat batch file that lets you move to any directory on any drive in one step. All you have to type is the drive letter and the name of the subdirectories, separated by spaces. For example, entering

```
2 D TURBOC INCLUDE
```

takes you to D:\TURBOC\INCLUDE from wherever you were. To go to a directory on the same drive, you don't have to type the drive letter. To go to the root directory of the current drive, just type 2.

If you specify a subdirectory that doesn't exist, the program brings you as far as it can. Say that you enter

```
2 A TURBOC FILES
```

and A:\TURBOC exists but A:\TURBOC \FILES doesn't. In this case, your directory will be changed to A:\TURBOC. Note that for the program to work properly, you'll have to rename any subdirectories that have the same name as drive letters.

Winston Lee
Montreal, Quebec
Canada

I really hate typing pathnames. First there's the reach for the Shift and Colon keys, then the repeated fumbling for the Backslash. It doesn't help any that keyboard manufacturers are still experimenting with different locations for the Backslash key! Since the 2.BAT program requires neither colons nor backslashes, it has earned a place in my daily batch file directory.

- **CHANGING DIRECTORIES:** This handy batch file lets you move to any directory on any drive in one step.
- **SAVING YOUR PLACE:** A couple of strange batch files let you save and restore the current directory.

If your system has more drives than A: through E:, just start another list of drive letters. For my own system, I added F: and G:. Remove the REM statement from the batch file to enable those two lines.

2.BAT is more forgiving than the CD command it replaces. If any element of a long pathname is invalid, CD will refuse to do anything. 2.BAT will at least change to the last valid element in your list, and there's a chance it will do even better than that. Suppose you have a directory C:\DATA\LETTERS, but you accidentally type

```
2 C DATA FILES LETTERS
```

2.BAT will change to drive C:, move to the DATA directory, and attempt to move to the FILES subdirectory. That subdirectory doesn't exist, as the "Invalid directory" message will show, but 2.BAT doesn't stop. It next tries to change to the LETTERS subdirectory, and succeeds! 2.BAT can't insert directories that you omit, but it *can* ignore erroneous items in the list.

2.BAT — COMPLETE LISTING

```
@ECHO OFF
FOR %%h IN (a A b B c C d D e E) DO IF (%1) == (%%h) %%h:
REM FOR %%h IN (f F g G) DO IF (%1) == (%%h) %%h:
FOR %%h IN (a A b B c C d D e E) DO IF (%1) == (%%h) SHIFT
REM FOR %%h IN (f F g G) DO IF (%1) == (%%h) SHIFT
FOR %%f IN (\ %1 %2 %3 %4 %5 %6 %7 %8 %9) DO CD %%f
```

Figure 1: Unlike the CD command, this batch file can move you to any directory on any drive, even if the parameters you give it aren't entirely correct.

SAVING YOUR PLACE

PC Magazine's PUSHDIR and POPDIR utilities (Programming/Utilities, May 27, 1986) are great to use, but memory-resident programs such as these gobble precious RAM, and they have the potential to crash the system when they conflict with other TSRs. I replaced them with short batch files that aren't memory resident but still maintain the ability to push and pop directories to any desired depth.

The technique is based on an idea originally submitted by J. Kevin Wells (*PC Magazine*, June 26, 1990). The basic routine is PUSHD.BAT:

```
@IF '%1'=='X' PROMPT @$N:$_@CD $P
@IF '%1'==''  %COMSPEC%/C %0
 X >C:\BATCH\POPD.BAT
```

This compact batch file stores the current drive and directory by creating a second batch file—POPD.BAT—which, when executed, returns to the original drive and directory. The commands are all contained in the PROMPT command on the first line.

The first time you run PUSHD, no parameter is supplied, so it's the second line that gets executed. Based on its value in the environment, %COMSPEC% /C temporarily loads a secondary command processor and executes the command line that follows. This command line is the name of the batch file itself with the parameter X. Executing PUSHD the second time with the X parameter alters the PROMPT and then executes the blank line at the end of the batch file. (The $_ characters in the prompt correspond to a CR/LF combination, creating the blank line.) When the secondary command processor encounters a blank line in a batch file, it issues the prompt when ECHO is ON (the default). This output is redi-

rected to the file POPD.BAT, which will have the following form:

```
@<drive>:
@CD <subdirectory>
```

which is just what we want. The secondary command processor always inherits the prompt from the primary command processor but not vice versa. So when you exit the secondary command processor, the default prompt is reestablished automatically.

When you finish with an application, you often want to return to your original drive and directory, and PUSHD is ideal for this. Let's say you use *WordPerfect* every day. Assuming that PUSHD is in a subdirectory on your path, you could create the following batch file:

```
@echo off
CALL PUSHD
C:
CD\WP
WP
CALL POPD
```

When you exit *WordPerfect*, the batch file automatically calls POPD—and you jump right back to your original directory.

PUSHDIRS.BAT, shown in Figure 2, extends this technique to storing multiple drives and directories. The basic idea is the same, except that PUSHDIRS sequentially creates batch files containing the current defaults. It also creates POPDIRS.BAT which executes these batch files in reverse order, returning you to the desired drive and directory. POPDIRS contains a line that transfers control back to PUSHDIRS in order to "clean the stack"—each batch file is deleted after execution.

The order in which this happens is determined by the FOR commands in PUSHDIRS. These loops may contain any number of different arguments, as long as the order in one is the reverse of the other's.

PUSHD and PUSHDIRS can be executed from a batch file or directly from the DOS command line. It's probably a good idea to keep them in a single subdirectory that's included in the PATH statement in your AUTOEXEC.BAT file. Better yet, copy everything to a RAM disk and then set the appropriate path.

Arneil P. Reyes
Los Alamos, New Mexico

PUSHDIRS.BAT — COMPLETE LISTING

```
@IF '%1'=='X' PROMPT @$N:$_@CD $P
@IF '%1'=='X' GOTO X
@ECHO OFF
IF '%1'=='Z' GOTO Z
SET D=
FOR %%A IN (3 2 1) DO IF NOT EXIST C:\BATCH\%%A SET D=C:\BATCH\%%A
IF NOT '%D%'=='' GOTO NotFull
ECHO Sorry, the directory stack is full!
REM > C:\BATCH\QUIT.BAT
QUIT
:NotFull
%COMSPEC%/C %0 X>%D%
ECHO @%0 Z >>%D%
GOTO Y
:Z
IF EXIST %D% DEL %D%
FOR %%A IN (1 2 3) DO IF EXIST C:\BATCH\%%A SET D=C:\BATCH\%%A
:Y
COPY %D% C:\BATCH\POPDIRS.BATCH >NUL
:X
```

Figure 2: This batch file creates files that save and restore multiple drive/directory pairs.

These are among the most cryptic batch files I've ever seen, but they work! Let's trace through PUSHD.BAT line by line.

The first line tests for a command line parameter of X. Since we didn't give it such a parameter, nothing happens. The test for *no* parameter in the second line succeeds, so the rest of that line gets executed. The %COMSPEC% environment variable gets expanded to the full pathname of your current command processor, usually COMMAND.COM. The %0 argument is replaced by the name of the currently running batch file. So this command calls a secondary command processor to run the same batch file again, with a command line parameter of X, and with *all* output redirected to the file POPD.BAT.

The second time through the batch file, the first line's IF test *is* true, so it changes the prompt. In a prompt string, $n signifies the current drive, $p the current directory, and $_ yields a new line. Hence this command sets a two-line prompt with the drive letter and a colon on the first line and a command to change to the directory that's current on the second.

The command line is no longer empty this second time around, so the second line doesn't execute. However, the blank third line causes DOS to display its prompt. We're redirecting all output, including this prompt, to POPD.BAT.

The nested batch file call is finished, so the secondary command processor terminates. Our change to the prompt only affected the secondary processor. When it ends, the prompt reverts to whatever it was before. Now POPD.BAT contains one line to return to the drive now current and a second line to return to the current directory.

Try tracing through PUSHDIRS.BAT the same way. It's a challenge, but I think you'll appreciate the intricate logic. I added a couple of lines to handle a stack-full situation. If you get a message indicating that the stack is full, it may mean that you should add more values to the two FOR loops in PUSHDIRS.BAT. You can also clear the stack by calling CLERSTAK.BAT:

```
@ECHO OFF
FOR %%v IN (1 2 3) DO IF EXIST
  C:\BATCH\%%v DEL C:\BATCH\%%v
```

Put a CALL to this batch file in your AUTOEXEC, so you start each day with a fresh directory stack. Do note that if you add items to the FOR loops in PUSHDIRS.BAT, you must do the same to CLERSTAK.BAT.

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edited by
Trudy Neuhaus

Languages

TRANSPORTING CONSTRUCTS

When an object instance is passed as a VAR parameter to a function or procedure, there is a chance that it will lose some of its distinguishing characteristics. Some of the fields and methods associated with the object may become unavailable, and attempts to reference these features will result in error messages. The features are still there, and it's possible to fool the compiler into using them with typecasting. But fooling the compiler into calling a method with the *wrong* typecast might send the program into never-never land.

Turbo Pascal, Version 5.5, has a facility for determining the actual type of an object instance: the TypeOf() function. Unfortunately, TypeOf() works only with a specific type. TypeOf() won't identify any descendants of the specific type, even though every descendant will inherit all of its fields and methods.

Other object-oriented programming languages can identify from which branch of the family tree a particular object swings. In Smalltalk, for example, the **IsKindOf: aClass** method returns true if the receiver is an instance of **aClass** or any of its subclasses. The IsKindOf method and its companion method, IsA (which is shown in Figure 1), are my efforts to implement similar methods predefined in Objective-C and discussed in Brad J. Cox's *Object Oriented Programming: An Evolutionary Approach* (Addison-Wesley, 1987). The method IsA, described as a *field* in Cox's book, is relatively simple, returning TypeOf(self). I usually define it at the top of the base hierarchy.

IsKindOf, on the other hand, navigates up the object hierarchy tree to locate an object's ancestors. It requires that each descendant object type implement its own version of the virtual method IsKindOf. This links each IsKindOf method with the parent IsKindOf method until a match of the TypeOf() functions is found, or until the top is reached, where the function is true only if the passed pointer matches TypeOf(base).

> ■ TRANSPORTING CONSTRUCTS: Build flexibility into Pascal by transporting constructs from other object-oriented languages.

The IsKindOf method allows you to use an appropriate typecasting of an object to access fields and methods that weren't defined for the base object type. For example, suppose XType, a descendant of the base type, defines a Boolean data field F. This field will continue to be defined for all descendants of XType, but it will not be defined for descendants of other types descended from base. Given an object Y, if

```
Y.IsKindOf(TypeOf(XType))
```

then the field F is accessible.

> If you program in Turbo Pascal 5.5, you must grasp the new kinds of compatibility between object types.

There is a cost to the added flexibility. At link time, TP5.5 removes any unreferenced code and data from the executable file. But establishing the VMT (Virtual Method Table) for an object references every virtual method. The constructor method initializes the VMT, so when a program calls an instance variable's constructor, all of that object type's virtual methods get linked into the executable.

However, TypeOf() also references the VMT. The IsKindOf method will reference the VMT of every object for which you create an instance and *all* of the object's ancestors as well. The code for *every* virtual method in these objects will be linked into the executable file even if you don't declare or use a single one of the ancestors!

Frequently, the ancestors' virtual methods are small, often little more than **BEGIN END;** pairs. So the problem is more potential than real. If it becomes more of a concern, the problem can be minimized by overriding IsKindOf only at critical generations (the ones that you are actually going to be testing) rather than for every single object.

J.W. Rider
San Diego, California

PC MAGAZINE If you're going to program in Turbo Pascal 5.5, you absolutely have to grasp the new kinds of compatibility between object types. The assignment **A := B;** is normally possible only if A and B are exactly the same type. But if A and B are objects, the assignment is also valid if B is of a type *descended* from A. B may have data fields and methods not present in A's type—these will be lost. The same is true of passing objects by reference to procedures or functions—any object of a descendant type can be passed, but if it has fields or methods not present in the ancestor type, they won't be available.

The procedure Test shown in the second column of Figure 1 takes two parameters of type **base**, one passed by value and the other by reference (a VAR parameter). When we pass the same variable in both parameters of Test, the one passed by value appears to be an instance of the **base** type. The variable passed by reference correctly retains its identity as

ISKIND.PAS — COMPLETE LISTING

```
PROGRAM iskind;
TYPE
  Pt = ^base;
  GrandAP = ^GrandA;
  GrandBP = ^GrandB;

  base = object
    CONSTRUCTOR Init;
    DESTRUCTOR Done;
    FUNCTION IsKindof(T:Pointer):boolean; virtual;
    FUNCTION IsA:pointer;
  END;

  ChildA = object(base)
    CONSTRUCTOR Init;
    FUNCTION IsKindof(T:Pointer):boolean; virtual;
    PROCEDURE WhoAreYou; virtual;
  END;

  ChildB = object(base)
    CONSTRUCTOR Init;
    FUNCTION IsKindof(T:Pointer):boolean; virtual;
  END;

  GrandA = object(ChildA)
    CONSTRUCTOR Init;
    FUNCTION IsKindof(T:Pointer):boolean; virtual;
    PROCEDURE WhoAreYou; virtual;
  END;

  GrandB = object(ChildB)
    CONSTRUCTOR Init;
    FUNCTION IsKindof(T:Pointer):boolean; virtual;
  END;

(**** All the constructors and the destructor: ***)
  DESTRUCTOR Base.Done; BEGIN END;

  CONSTRUCTOR Base.Init; BEGIN END;
  CONSTRUCTOR ChildA.Init; BEGIN END;
  CONSTRUCTOR ChildB.Init; BEGIN END;
  CONSTRUCTOR GrandA.Init; BEGIN END;
  CONSTRUCTOR GrandB.Init; BEGIN END;

(**** The IsA method, used by all objects in the hierarchy: ****)
  FUNCTION base.IsA:pointer; BEGIN IsA:= TypeOf(self); END;

(**** All the IsKindOf methods: ****)
  FUNCTION base.IsKindof(T:Pointer):boolean;
  BEGIN IsKindof := (T=TypeOf(base)); END;

  FUNCTION ChildA.IsKindof(T:Pointer):boolean;
  BEGIN IsKindof := (T=TypeOf(ChildA)) OR base.IsKindof(T); END;

  FUNCTION ChildB.IsKindof(T:Pointer):boolean;
  BEGIN IsKindof := (T=TypeOf(ChildB)) OR base.IsKindof(T); END;

  FUNCTION GrandA.IsKindof(T:Pointer):boolean;
  BEGIN IsKindof := (T=TypeOf(GrandA)) OR ChildA.IsKindof(T); END;

  FUNCTION GrandB.IsKindof(T:Pointer):boolean;
  BEGIN IsKindof := (T=TypeOf(GrandB)) OR ChildB.IsKindof(T); END;

(**** WhoAreYou methods, for the objects that have them: ***)
  PROCEDURE ChildA.WhoAreYou; BEGIN WriteLn('I am a ChildA'); END;

  PROCEDURE GrandA.WhoAreYou; BEGIN WriteLn('I am a GrandA'); END;

  PROCEDURE Test(B1:Base; VAR B2 : base);
  BEGIN
    Write('The variable passed by reference SEEMS to be a ');
    IF B1.IsA = TypeOf(base) THEN WriteLn('base type');
    IF B1.IsA = TypeOf(ChildA) THEN WriteLn('ChildA type');
    IF B1.IsA = TypeOf(GrandA) THEN WriteLn('GrandA type');
    Write('The variable passed by value is a ');
    IF B2.IsA = TypeOf(base) THEN WriteLn('base type');
    IF B2.IsA = TypeOf(ChildA) THEN WriteLn('ChildA type');
    IF B2.IsA = TypeOf(GrandA) THEN WriteLn('GrandA type');
  END;

VAR P : Pt;
BEGIN
  P := New(GrandAP, Init);
  Test(P^, P^);

  If P^.IsKindof(TypeOf(ChildA)) THEN
    BEGIN
      Write('The object says --> ');
      ChildA(P^).WhoAreYou;
    END
  ELSE WriteLn('The object does not have a "WhoAreYou" method.');
  Dispose(P,done);

  P := New(GrandBP, Init);
  If P^.IsKindof(TypeOf(ChildA)) THEN
    BEGIN
      Write('The object says --> ');
      ChildA(P^).WhoAreYou;
    END
  ELSE WriteLn('The object does not have a "WhoAreYou" method.');
  Dispose(P,done);

  (* ChildA(P^).WhoAreYou;) *)(*This line will crash your system*)
END.
```

Figure 1: The IsKindOf method gives Turbo Pascal 5.5 the functionality of QuickPascal's built-in Member function.

an instance of the GrandA type.

The best solution to this problem is simply not to *make* assignments between objects. If the object has any virtual methods, the assignment isn't valid anyway—such an object *must* be initialized by its constructor. Instead, use pointers to objects, or pass them as VAR parameters. A pointer to an object type can actually point to that type or any descendant, and the compiler *can* call the correct virtual method automatically.

Figure 1 also demonstrates a use of the IsKindOf method. The object hierarchy branches just below the base object—the ChildA branch adds a method WhoAreYou, the ChildB branch does not. Each branch has a descendant, a grandchild type. The variable **P** is a pointer to the **base** type, but it can actually point to any of the object types in the hierarchy. If the actual instance pointed to by the variable **P** is in the "A branch" of the hierarchy, you can call the WhoAreYou method. However, if it's in the "B branch," you can't. Using the IsKindOf function, the program determines whether the method call is permissible.

> Be warned that checking the type of an object comes close to violating encapsulation.

Do be warned that checking the actual type of an object comes close to violating encapsulation. Strictly speaking, you shouldn't *need* to know what type an object is. In the above example, an empty WhoAreYou method in the base type would also solve the problem. IsKindOf simply gives us an alternative.

QuickPascal users, don't feel left out. True, you don't have a TypeOf function, but you don't need it. The QuickPascal Member function returns true if the instance variable is of the particular object type or that of any of its descendants. It eliminates the need to add a separate IsKindOf method to each of your objects—very convenient.

—*Neil J. Rubenking*

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by
Jeff Prosise

Tutor

■ EXPLORING THE ROM BIOS: How programs and operating systems communicate with devices attached to your PC.

EXPLORING THE ROM BIOS

BIOS stands for *Basic Input/Output Subsystem*. It gets this name because it contains an extensive collection of input/output (I/O) routines, which programs and operating systems can call upon to communicate with devices attached to the PC. The name itself was probably borrowed from the CP/M operating system, which contained a BIOS module in software that provided machine-specific interfaces to the hardware the operating system was run on. The BIOS on the PC is encoded in ROM, so you'll often hear it called the *ROM BIOS*.

Physically, the BIOS is a chip or set of chips that plugs into your machine's system board. Some adapters such as EGA and VGA video cards and disk controllers contain their own BIOSes, which supplement the main BIOS. In many cases, the routines stored in these adapter BIOSes replace routines in the system board BIOS. The industry's two preeminent PC manufacturers, IBM and Compaq, write their own BIOS code. Most smaller manufacturers depend on compatible BIOSes from companies such as Phoenix, Award, and AMI. IBM published the commented source code listings for the PC, XT, and AT BIOSes in the technical reference manuals for those computers. If you can lay your hands on one of these documents and aren't intimidated by long assembly language listings, you can get a good idea of what BIOS code looks like and see how the BIOS interfaces with individual devices.

Routines in the BIOS are accessed via *software interrupts*—CPU instructions that pass control from the program currently executing to an interrupt handler that lies elsewhere in memory. At start-up, the BIOS initializes certain interrupt vectors in the PC's interrupt vector table (which occupies the first 400h bytes of memory) to point to interrupt handlers within itself. When DOS or an application program calls an interrupt, the interrupt handler pointed to by that interrupt vector gets called. The interrupt handler executes a particular function selected by the AH register. This way, the actual address of the routine is irrelevant; all the caller has to do is know the function code and interrupt number for the service it wants to invoke.

Figure 1 illustrates where the BIOS, acting as a low-level interface to the hardware in a PC, fits into the system. DOS uses routines in the BIOS exclusively to interact with devices such as the screen, keyboard, and printer. For example, to throw a character up on the screen, DOS passes an ASCII code to the CON device driver through interrupt 29h, also known as the *Fast Console Output Interrupt* (see the February 12, 1991, Tutor column for an explanation). CON in turn calls the BIOS Write Teletype function (interrupt 10h function 0Eh) in the video BIOS to display the character. If ANSI.SYS has replaced CON, it does the same thing but uses the BIOS Write Character and Attribute function (interrupt 10h function 09h).

Similarly, the PRN device driver uses interrupt 17h, the entry point to the BIOS printer I/O services, to output characters to the printer. And in one of the very few instances when DOS uses the BIOS directly rather than using one of its own device drivers, it calls the BIOS Scroll Active Video Page Up function to clear the screen when you type CLS (unless ANSI.SYS is loaded; in this case it clears the screen by transmitting a clear screen escape sequence to ANSI.SYS).

Application programs aren't nearly so well behaved. They're liable to use services in the DOS kernel or BIOS or to program the hardware directly, depending on which is the most convenient or the fastest. For direct device I/O, most programs opt for BIOS services rather than DOS services, because the former are generally more powerful and less susceptible to outside influences, like presses of Ctrl-C or redirection operators. In some cases, even the BIOS isn't enough. For example, most applications that use the serial ports program the UART chips that drive the serial ports themselves, because neither DOS nor the BIOS can support communication rates higher than about 1,200 bits per second with the primitive serial port I/O functions built into them.

BIOS SERVICES

Ignoring some of the less-common BIOS functions, the device I/O services the BIOS

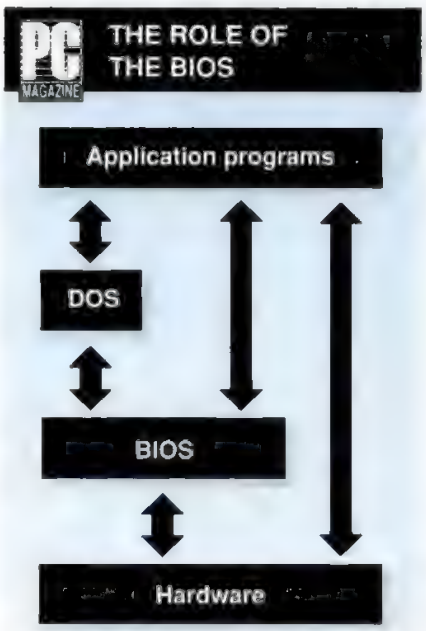

Figure 1: The BIOS offers a broad set of I/O routines that programs and operating systems can use to interface with the hardware they're run on.

provides fall into seven major categories:

- Video services (interrupt 10h)
- Disk services (interrupt 13h)
- Serial port services (interrupt 14h)
- System services (interrupt 15h)
- Keyboard services (interrupt 16h)
- Parallel printer services (interrupt 17h)
- Time and date services (interrupt 1Ah)

These services are summarized by interrupt and function number in Figure 2. Not all the BIOS services are shown. I've omitted some that are rarely used or that appeared only in PCs that are now defunct (for example, the PC*jr*). Also, not all the services listed are available on all PCs. Whether or not a function is supported by the BIOS depends on several factors, including the type of PC, the hardware that's installed, the brand of BIOS you're using, and the date it was written. It's not unusual for programs to restrict themselves to a narrow range of BIOS calls so that they can run without modification on a wider variety of machines. For example, not many programs call on the video BIOS's Write String function, even though it's a very convenient one to use. This function isn't implemented on video adapters predating the EGA, so using it renders a program incompatible with systems equipped with CGA and MDA video cards.

The list in Figure 2 will give you some idea of the breadth of services the BIOS offers. Unfortunately, it's not possible to examine them all in the space we have here. For additional information on these services, there are many references available at local bookstores, including Ray Duncan's *Advanced MS-DOS*, from Microsoft Press. You may also order IBM's official reference to BIOS services, the *Personal System/2 and Personal Computer BIOS Interface Technical Reference* (part number 68X2341), by calling 800-IBM-PCTB. The cost is (ouch!) $150. A supplement (part number 15F2161) is available for an additional $18.

SUMMARY OF BIOS SERVICES

INTERRUPT 10H: VIDEO SERVICES	
Function 00h	Set video mode
Function 01h	Set cursor type
Function 02h	Set cursor position
Function 03h	Read cursor position
Function 04h	Read light pen position
Function 05h	Select active video page
Function 06h	Scroll active video page up
Function 07h	Scroll active video page down
Function 08h	Read character and attribute
Function 09h	Write character and attribute
Function 0Ah	Write character only
Function 0Bh	Set color palette
Function 0Ch	Write dot (pixel)
Function 0Dh	Read dot (pixel)
Function 0Eh	Write teletype
Function 0Fh	Get video parameters
Function 10h	Set palette registers
Function 11h	Program character generator
Function 12h	Alternate select (miscellaneous EGA/MCGA/VGA video services)
Function 13h	Write string

INTERRUPT 13H: DISK SERVICES	
Function 00h	Reset disk
Function 01h	Read status of last operation
Function 02h	Read sector or sectors
Function 03h	Write sector or sectors
Function 04h	Verify sector or sectors
Function 05h	Format track or cylinder
Function 06h	Format track or cylinder and set bad sector flags
Function 07h	Format disk
Function 08h	Read drive parameters
Function 09h	Initialize drive pair characteristics
Function 0Ch	Seek to track or cylinder
Function 0Dh	Reset disk (alternate)
Function 10h	Test for drive ready
Function 11h	Recalibrate drive
Function 15h	Get drive type
Function 19h	Park heads

INTERRUPT 14H: SERIAL PORT SERVICES	
Function 00h	Initialize serial port
Function 01h	Transmit character
Function 02h	Receive character
Function 03h	Get serial port status
Function 04h	Initialize serial port (extended)
Function 05h	Get or set modem status register

INTERRUPT 15H: MISCELLANEOUS SYSTEM SERVICES	
Function 00h	Turn cassette motor on
Function 01h	Turn cassette motor off
Function 02h	Read blocks from cassette
Function 03h	Write blocks to cassette
Function 4Fh	Intercept keyboard data
Function 85h	SysRq key pressed
Function 86h	Pause for specified length of time
Function 87h	Move a block of data from one location in memory to another in protected mode
Function 88h	Get size of extended memory
Function 89h	Switch CPU to protected mode
Function C0h	Get system configuration parameters
Function C1h	Get address of extended BIOS data area
Function C2h	PS/2 mouse interface
Function C3h	Enable or disable watchdog time-out
Function C4h	PS/2 Programmable Option Select interface

INTERRUPT 16H: KEYBOARD SERVICES	
Function 00h	Read keyboard
Function 01h	Get keyboard buffer status
Function 02h	Get shift status
Function 03h	Set typematic and delay rates
Function 05h	Write character to keyboard buffer
Function 10h	Read Enhanced keyboard
Function 11h	Get Enhanced-keyboard buffer status
Function 12h	Get Enhanced-keyboard shift status

INTERRUPT 17H: PARALLEL PRINTER SERVICES	
Function 00h	Print character
Function 01h	Initialize parallel port
Function 02h	Get parallel port status

INTERRUPT 1AH: TIME AND DATE SERVICES	
Function 00h	Read system timer
Function 01h	Set system timer
Function 02h	Read time
Function 03h	Set time
Function 04h	Read date
Function 05h	Set date
Function 06h	Set alarm
Function 07h	Reset alarm

Figure 2: Routines in the BIOS are accessed via software interrupts—CPU instructions that pass control from the program currently executing to an interrupt handler.

MORE THAN I/O

In addition to these low-level hardware interface routines, the BIOS contains the code for the Power-On Self Test, or POST, and the bootstrap loader. The POST is the series of diagnostic routines, executed when you turn your PC on, that ensure the hardware components of the system are working properly. The POST was discussed in the February 19, 1990, Tutor column. The bootstrap loader is the routine that reads the boot sector from a DOS disk and transfers control to the boot sector's code that loads (bootstraps) the operating system into memory.

The BIOS also contains handlers for selected hardware interrupts. For example, every time channel 0 of the PC's system board timer produces a clock pulse (it does so approximately 18 times every second), a hardware interrupt is generated that activates a BIOS interrupt handler. The interrupt handler updates the system's software clock and performs other housekeeping chores. Another example: When a key is pressed or released, the BIOS fields the interrupt generated by the keyboard controller and reads a scan code from the keyboard. After converting the scan code into the equivalent ASCII

code based on any other keys depressed at the same time (for example, Ctrl, Alt, or Shift) and the current states of NumLock and CapsLock, the interrupt handler stuffs the key code into the keyboard buffer. The BIOS also houses the code that dumps a screen to the printer when the Print Screen key is pressed.

Another element that mustn't be excluded from a survey of the BIOS is the PC's *Hard Disk Parameter Table*. This ROM-based table defines the characteristics (for example, the number of heads, sectors, and cylinders) of all the different hard disks that can be installed in the PC. Generally, adding a hard disk whose properties do not appear in this table requires that you purchase a BIOS upgrade or install a third-party support utility such as Ontrack's *Disk Manager*.

THE BIOS DATA AREA

The 256-byte region of RAM that immediately follows the Interrupt Vector Table and stretches from absolute address 400h to 4FFh is set aside for use by routines in the BIOS. This area is called the *BIOS Data Area*. Figure 3 lists some of the information the BIOS places there. Programs can inspect memory locations in this region and obtain valuable information about the state of the system. From the byte at 484h, for example, a program can determine how many lines of text are currently displayed on a system equipped with an EGA, VGA, or XGA video adapter.

Sometimes it's useful to manipulate data in this region. You can clear the keyboard buffer by reading the word value at 41Ah and poking it into address 41Ch. These locations hold the head and tail addresses of the keyboard buffer, so setting them equal to each other tricks the BIOS into thinking that there are no more key codes awaiting processing.

PS/2s set up an additional data area in RAM for the BIOS's use, called the *Extended BIOS Data Area*. At start-up, the PS/2 POST determines how much conventional memory is installed and cordons off an area at the very top for the BIOS to use as a scratch pad. The size of this area is normally 1K. However, the designers of the PS/2 made provisions for more. The address of the Extended BIOS Data Area is obtained by placing a call to interrupt 15h function C1h. The first byte in the data area reveals the size of the area in kilobytes, so theoretically, up to 255K could be reserved this way. The PS/2 hides the RAM it sets aside for the BIOS in such a way that the rest of the system doesn't even know the RAM is installed.

THE BIOS DATA AREA

Address	Size	Description
		SERIAL PARALLEL PORT DATA AREA
400h	4 words	Base I/O address for COM1 through COM4
408h	4 words	Base I/O address for LPT1 through LPT4
		MISCELLANEOUS DATA AREA
410h	Word	Equipment flags
413h	Word	Memory size in kilobytes
		KEYBOARD DATA AREA 1
417h	Byte	Keyboard shift state flags 1
418h	Byte	Keyboard shift state flags 2
419h	Byte	Alternate keypad entry
41Ah	Word	Address of keyboard buffer head
41Ch	Word	Address of keyboard buffer tail
41Eh	32 bytes	Keyboard buffer
		FLOPPY DISK DRIVE DATA AREA
43Eh	Byte	Recalibrate status
43Fh	Byte	Motor status
440h	Byte	Motor off counter
441h	Byte	Status of last operation
442h	7 bytes	Controller status bytes
		VIDEO DATA AREA 1
449h	Byte	Current video mode
44Ah	Word	Number of columns of text displayed
44Ch	Word	Length of regen buffer in bytes
44Eh	Word	Offset address of active display page
450h	8 words	Cursor position (video page 0–7)
460h	Word	Cursor type (beginning and ending scan lines)
		VIDEO DATA AREA 1 (cont.)
462h	Byte	Active video page
463h	Word	CRT controller base address
465h	Byte	Current setting of 3x8 register
466h	Byte	Current setting of 3x9 register
		SYSTEM TIMER DATA AREA
46Ch	Word	Low word of timer count
46Eh	Word	High word of timer count
470h	Byte	Timer rollover indicator
		SYSTEM DATA AREA 2
471h	Byte	Break-key state
472h	Word	Reset flag
		HARD DISK DATA AREA
474h	Byte	Status of last operation
475h	Byte	Number of hard disks attached
		TIME-OUT VALUES
478h	4 bytes	Time-out value for LPT1 through LPT4
47Ch	4 bytes	Time-out value for COM1 through COM4
		KEYBOARD DATA AREA 2
480h	Word	Address of start of keyboard buffer
482h	Word	Address of end of keyboard buffer
		VIDEO DATA AREA 2
484h	Byte	Number of rows of text displayed minus 1
485h	Word	Height of character in scan lines
487h	Byte	Miscellaneous video information
488h	Byte	Miscellaneous video information

Figure 3: The BIOS Data Area comprises a 256K area of RAM stretching from absolute address 400h to 4FFh.

THE ABIOS

The Extended BIOS Data Area wasn't the only wrinkle that PS/2s introduced to the BIOS. Most PS/2s actually contain two BIOSes: the CBIOS, a superset of the original IBM BIOS (the C stands for Compatibility), and the ABIOS, or *Advanced BIOS*, which supports multitasking operating systems such as OS/2. The ABIOS is the protected-mode analog to the CBIOS. When OS/2 is run on an AT-class machine, it bypasses the BIOS and interacts with the hardware directly. On a PS/2, however, it relies on functions in the ABIOS. In this respect, the ABIOS (when it is present) plays exactly the same role in a system running OS/2 that a conventional BIOS does in a system running DOS.

In the first IBM PC, the BIOS was a mere 8K in length; the PS/2 BIOS now stands at 128K. With this kind of growth, who knows what the next ten years of BIOS development will bring!

ASK THE TUTOR

The Tutor solves practical problems and explains techniques for using your hardware and software more productively. Questions about DOS and systems in general are answered here. To have your question answered, write to Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016, or upload it to PC MagNet (see page 8 for instructions). We regret that we're unable to answer questions individually. ■

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RADIO RELAY

I've been a ham—an amateur radio operator—since 1955. I've sent signals through the Orbiting Satellites Carrying Amateur Radio (OSCAR), exchanged slow-scan television pictures with hams around the world, and handled emergency messages during earthquakes and hurricanes. The hobby has given me decades of enjoyment, but the Morse code test requirement was a barrier that kept many people from entering amateur radio.

In February 1991, however, the FCC created a class of amateur radio privileges open to any United States citizen who can pass a written test on technical subjects and operating rules. The aspect of this code-free license that will be interesting to many *PC Magazine* readers is the ability to use a technique called *packet radio* for the transmission of electronic mail and data files. Packet radio lets you tie your PC to a small radio transceiver operating in the frequencies above 30 MHz so that you can send and receive messages through the thousands of automated relay stations established by hams across the U.S. and Canada. Packet and voice radio transmission in frequencies above 30 MHz requires only small antennas and relatively inexpensive equipment. It is useful for emergency and disaster communications as well as for other not-for-profit activities.

For additional information about packet radio and the code-free license, call the American Radio Relay League at 203-666-1541, or write Code-Free License, ARRL, 225 Main Street, Newington, CT 06111.

MAINTAINING RELIABLE POWER

Your column recently pointed to batteries as the weak link in UPS performance, and I thought I'd add the viewpoint of an experienced manufacturer.

In the manufacture of a typical desktop battery backup system, batteries account for about 25 to 33 percent of the cost of the unit. They are notoriously odd in their performance characteristics in that they respond very differently to seemingly similar loads and chargers.

By far the biggest variable in battery performance is ambient operating temperature. One of the most important things you can do to improve battery life is keep the UPS running in a cool, dry place.

While it's true that huge UPS systems aren't required for PCs, we always operate on the principle that the larger the battery, the less strain on the battery per blackout occurrence and the longer the life of the battery.

Remember, too, that the boom in battery backup systems began in the late 1980s, so many of the devices in use today have batteries that are 3 to 5 years old—about the life expectancy of a good-quality battery.

Keelin Wyman
Chicago, Illinois

PC MAGAZINE Wyman works for a major manufacturer of UPS products, and his letter contains a couple of good hints. The conclusion to draw here is that if you rely on UPS systems with batteries entering the third to fifth years of their lives, it's about time to replace them—no matter their apparent condition. A smart LAN administrator will budget for battery changes on a regular basis.

PRINTING ON AN OS/2 LAN

I administer a LAN running IBM OS/2 *LAN Server* with a mixture of PC DOS 4.01 and IBM OS/2 workstations, and three print servers running IBM's *PC LAN* 1.3.

While some programs like *WordPerfect* 5.1 work beautifully from the OS/2 DOS box, others, such as *Harvard Graphics*, will not print. This means that the OS/2 users must log on to one of the DOS workstations in order to print from such programs. The problem is that, under OS/2 *LAN Server*, printer assignments are part of the user's log-on routine. So, when using a different workstation, the user must manually reassign his network printers to the printer at hand. I decided that making the printer assignments workstation-dependent would make the network more user-friendly.

The print server names are PRINT1, PRINT2, and PRINT3, corresponding to three Hewlett-Packard printers named HP1, HP2, and HP3. LPT2 receives the network printer assignment, while LPT1 remains the local printer.

I removed all printer references from the Manage Logon Printer Assignments screen for each user. Then I added a statement in the CONFIG.SYS file for OS/2 workstations (and the AUTOEXEC .BAT file for DOS workstations), which sets an environment parameter PID (printer identification) to the number of the

print server nearest the workstation. For example,

```
SET PID=1
```

Next, I added the following statement to the user profiles (PROFILE.CM for OS/2, PROFILE.BAT for DOS):

```
NET USE LPT2:
 \\PRINT%pid%\HP%pid%
```

Now, when a user logs on, the profile is executed and **%pid%** is read from the local environment to attach the workstation to the closest print server.

I could have accomplished the same thing by setting an environment variable to the entire NET USE statement:

```
SET PRINT_CONNECT=NET USE LPT2:
 \\PRINT2\HP2
```

and included the statement

```
%PRINT_CONNECT%
```

in each user profile on a line by itself. This method produces the same result but requires more local environment space.

Kenneth Steven Reiss
Passaic, New Jersey

Novell network managers have found dozens of different uses for environment variables established with the SET command, but this is the first input we've received from someone using *LAN Server* (the IBM version of Microsoft's *LAN Manager)*. This clever use of environment variables will work with any of the dozens of LAN operating systems that use the Microsoft NET USE command syntax.

KEEPING COOL

Here's another product network administrators should be aware of. I've seen a lot of file servers locked in closets or other small, poorly ventilated rooms. I've seen their fans clogged with dust because they are never turned off, never moved, and never cleaned.

Overheating kills electronic components, but a company called SIA (312-440-1275) has a product you can install on its 386 and 486 servers that lets these computers keep cool in hot, dusty, and sandy environments. The closed-cycle cooling system has no moving parts, and it doesn't use fluids or fluorocarbons, making it safe both for the computer and the environment.

The system uses a technology called the *Peltier effect* to transfer heat through the action of dissimilar semiconductor metals. No outside air is drawn in, so there is no dust to clog the fan or the filters of the hard disk drives.

The SIA solid-state air conditioning system adds $5,825 to the cost of the servers, but that could be cheaper over the long run than installing a separate cooling system or replacing a server that overheated in a poorly ventilated space.

ROLE REVERSAL

I've read several articles on X Window, but I'm still confused about what constitutes an X Window server. Can you help?

Roger Ullman
Denver, Colorado

X Window was developed by the Massachusetts Institute of Technology with the support of many computer companies—particularly those in the Unix market. It is both a networking system and a network-based protocol for moving graphics images. The idea behind X Window is the same as that behind all networking: sharing resources.

In traditional LANs, several users and their applications share resources such as files or printers on a computer acting as a server. X Window reverses the roles of client and server: The user sits at the machine that's acting as the server, while client applications may run on either the same machine or others.

In an X Window system, several applications share a networked node called a display server or an X terminal. The user sits at the display server to run the applications (because that's where the display is) while the programs execute on other computers. Someone sitting at an X Window display server could run several applications simultaneously: one on a Unix workstation, one on a DOS PC, and a third on a minicomputer. Of course, the applications must conform to the X Window protocol so that they can send images to the display server, but more than 100 CAD and similar applications for operating systems as diverse as Unix, AIX, Pick, NeXT, and DOS now support X Window.

Today, expensive resources to be shared on a network include large-screen monitors and high-quality graphics boards. One of these, Ultra X, from Princeton Graphics Systems was recently brought to PC Magazine LAN Labs for a demonstration.

The Ultra X provides 1,280-by-1,024 color graphics resolution and houses a special graphics processor that can use up to 8MB of RAM. You hook it directly to any Ethernet network, and it uses TCP/IP for communications across the network. Prices range from $1,995 to $5,995. For more information on how to avoid buying everyone in your organization his own big monitor and expensive graphics adapter, contact Princeton Graphics at 404-664-1010 and ask about the Ultra X.

POWER QUALITY

I read your article on UPSs in the November 27, 1990, issue of *PC Magazine* ("*Building Workgroup Solutions: LAN Server UPSs*"), and I have one question. You mentioned that IBM and AT&T had conducted power surveys—where can we get more information and statistics on power-line characteristics?

Peter Holt
Berkeley, California

IBM performed a study, now referred to as the Allen and Segall power quality study, on 29 sites from 1969 to 1972. AT&T conducted a similar study on 24 sites from 1977 to 1979. Obviously, the data from these studies isn't very fresh.

The National Power Laboratory (a division of Best Power Technology) is currently conducting an extensive new study that is monitoring 35 sites throughout the U.S. and Canada. The survey will extend through 1995 and eventually log 235 sites. Preliminary reports will be issued in 1991. Contact the National Power Laboratory at 608-565-7200 for details.

NETWORK YOUR QUESTIONS

Connectivity gives you practical solutions to networking problems of all types. We pay $50 for any tip we print. Please submit your letter on a disk along with a printout. Mail your contribution to Connectivity, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named PC MAGAZINE LAN LABS). We are unable to answer letters individually. ■

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FastData 386/33 $2399

The fastest 386 processor available combined with a 64K thirty nanosecond memory cache make the FastData 386/33 a power users dream! Included in the base price is a 100 megabyte 20 millisecond hard disk, 1024 by 768 VGA monitor and card, four megabytes of memory, and 5.25" & 3.5" high capacity floppy drives. Plus, should anything ever go wrong with your FastData computer, you are covered by a one-year warrantee with free on-site service or system replacement if we cannot correct the problem with our FastSHIP advance parts replacement program.

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- ✓ 8 expansion slots & 5 drive bays.
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- ✓ Windows & Mouse add $99.
- ✓ FCC Class B approved.

386/33	80 IDE	100 IDE	200 IDE	330 ESDI
Mono	$2,009	$2,089	$2,399	$3,159
VGA White	$2,109	$2,189	$2,499	$3,259
VGA Color	$2,259	$2,339	$2,649	$3,409
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FastData 386/25 $1999

The optimum combination of features, expandability, and power make the FastData 386/25 an ideal choice for those whose applications demand high speed 32 bit processing and expandability. The value of the 386/25 goes far beyond its price; it comes configured with a a full four megabytes of fast RAM, a quick 22 millisecond 65 megabyte hard disk, and maximum VGA displaying 1024 by 768 resolution powered by a high-output 16 bit 512K VGA board. Also, the FastMicro team will configure your FastData 386 exactly the way you want, without sending you shopping elsewhere.

Standard Features

- ✓ 25mhz Intel 80386-DX.
- ✓ 4 megabytes of high speed RAM.
- ✓ 80 mb 20ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. (For both add $69)
- ✓ Standard chassis (shown on left) with keylock, speed and reset buttons.
- ✓ 80387-DX coprocessor socket.
- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor, 1024x768 resolution, with 16 bit VGA card with 1mb Video Ram.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots & 5 drive bays.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ FCC Class B approved.

386/25	40 IDE	80 IDE	100 IDE	200 IDE
Mono	$1,539	$1,689	$1,769	$2,079
VGA White	$1,639	$1,789	$1,869	$2,179
VGA Color	$1,789	$1,939	$2,019	$2,329
VGA 1024	$1,849	$1,999	$2,079	$2,389

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Call about our hot 486, just $3,099 with the same standard features as our 386-33 system. Includes a 128K two-stage cache and is expandable to 64mb of memory.

All FastData Systems Include:

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FastData SX Systems

$1599 FastData SX/20

25% faster than a 16mhz SX, the FastData SX/20 adds even greater performance to its 386 multitasking capabilities. Just $200 more than our SX/16, this machine also includes a second floppy drive in addition to the standard VGA color monitor and 16 bit VGA adaptor, Keytronics keyboard and 40 megabyte hard drive. The system includes two megabytes of memory and is expandable to eight on the main system board. Remember, when you have questions, need to solve a problem, or want recommendations on products for your system, the FastMicro team is standing by toll-free to provide product support for as long as you own your FastData personal computer.

Standard Features

- ✓ 20mhz Intel 80386-SX processor.
- ✓ 2 megabytes of high speed RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" and 1.44mb 3.5" floppy drives.
- ✓ Standard chassis (shown) with keylock, speed and reset buttons.
- ✓ 200 watt power supply
- ✓ 14" Super VGA color monitor with 16 bit VGA card with 512K.
- ✓ Clock calendar, parallel port, two serial ports, and game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

SX/20	40 IDE	80 IDE	100 IDE	200 IDE
Mono	$1,289	$1,439	$1,519	$1,829
VGA White	$1,389	$1,539	$1,619	$1,929
VGA Color	$1,539	$1,689	$1,769	$2,079
VGA 1024	$1,599	$1,749	$1,829	$2,139

$1399 FastData 386/SX

Combine the benefits of an advanced Intel 386 processor, the value of a 286 and the advantages of FastData and you've got the FastData 386/SX! This machine is the choice of those who want to run today's powerful 386 and multitasking software, like Windows, and also want to run their favorite DOS applications at surprising speeds. We've made our customers' favorite options standard: it comes with an ample two megabytes of memory, a high performance 40mb hard drive, and 16 bit color VGA. Compare performance, features, and service and you will find no better SX value. Interested further? Try the FastData 386/SX for 30 days; you have to be happy - if not, we'll take it back.

Standard Features

- ✓ 16mhz Intel 80386-SX processor.
- ✓ 2 megabytes of high speed RAM.
- ✓ 40 mb 28ms IDE hard disk, 1:1 interleave.
- ✓ 1.2mb 5.25" or 1.44mb 3.5" floppy drive. Both add $69.
- ✓ Standard chassis with keylock, speed and reset buttons (mini desktop shown - add $50).
- ✓ 200 watt power supply
- ✓ 14" VGA color monitor with 16 bit VGA card with 256K.
- ✓ Clock calendar, parallel port, two serial ports, and a game port.
- ✓ Keytronics 101 key keyboard.
- ✓ 8 expansion slots, 5 drive bays.
- ✓ 80387-SX coprocessor socket.
- ✓ Full Shadow RAM and LIM 4.0 EMS support.
- ✓ Windows & Mouse add $99.
- ✓ Guaranteed compatible.
- ✓ FCC Class B approved.

386/SX	40 IDE	80 IDE	100 IDE	200 IDE
Mono	$1,149	$1,299	$1,379	$1,689
VGA White	$1,249	$1,399	$1,479	$1,789
VGA Color	$1,399	$1,549	$1,629	$1,939
VGA 1024	$1,459	$1,609	$1,689	$1,999

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Conner *(see IDE controllers below)*	
CP3044 40mb IDE 28ms	269
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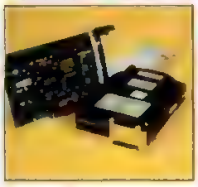
CP3208 200mb IDE 25ms	849



Seagate 89mb AT Kit

$399 IDE performance, big 89 megabyte capacity and Seagate quality make this kit a great buy. A 19ms access time and 5 mbps transfer rate assure great performance. Controller cables and rails are included to make installation fast and easy.

Micropolis	
MC1664 340mb ESDI 14ms	1295
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NEC CDR-3501 Ext. CD-ROM w/interface	549
Plus Development	
HardCard IIXL 50 - 52mb 9 ms 16bit	399
HardCard IIXL 105 - 105mb 9 ms 16bit	679
Impulse 42mb 12 ms 16bit IDE Kit	399
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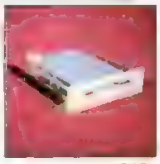
Toshiba 1.44mb Floppy Drive $69



Complete with mounting brackets and installation instructions, this Toshiba works in all true 286 & 386 compatibles. Will also read/write/format 720K 3.5 disks. Rails, add $5.

Seagate	
30MB XT Kit ST238 w/ cont.	249
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80MB AT ST296N SCSI Drive w/adaptor	349
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125MB ST1144A 19ms IDE Drive	469
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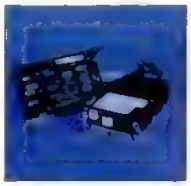
330MB ST2383E 16ms ESDI Drive	1289
Teac	
1.2MB 5.25" Floppy	65
1.44MB 3.5" Floppy	65

Toshiba 100mb IDE Kit $489



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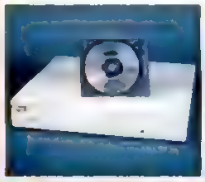
WD93044 40mb IDE 28ms	199
WDAC280 80mb IDE 28ms	339
WE1007V-SE2 ESDI AT 1:1 dual controller	149



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New and improved, the ATI VGA *WONDER+* is faster than VRAM. It does interlaced and non-interlaced 1024x768 modes, is 100% register compatible, and comes with extensive software drivers. A free mouse is included as an added bonus. 512K version $219.

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2400 ETC External	187
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VGA Basic 16	75
VGA Wonder + 256K	189
VGA Wonder + 512K	229
Brown Wagh Sound Blaster	149
Everex	
2400B Int Modem	99
EGA 480 Card	69
RAM3000 16 bit RAM card	75
RAM8000 16 bit RAM card	169
Hayes	
JT FAX 4800B Internal	139
Personal Modem 2400 w/Prodigy	119
Hercules Graphic Card +	169
Intel	
Classic 2400 Modem Int /Ext	137/167
Satisfaxtion Classic - Internal 9600	379
8087-2	115
287XL	199
387-DX25	479
387-SX16/20	319/349
Logitech	
ScanMan Plus	165
Scanman 256	289
Orchid	
ProDesigner II 512/1mb	279/329
Tiny Turbo 286	207
Tiny Turbo Xtra	267

[illegible] $449

This external modem features V.42 and MNP error correction combined with MNP/5 and V.42 bis data compression to provide total high speed throughput. The PM9600SA is also V.32 TCM, V.32, V.22 compliant and comes with a five year guarantee.

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VGA 1024 256K/512K	175/199
Practical Peripherals	
2400B Int Modem	125
2400B Int with MNP	169
PM9600SA Ext V.32/V 42bis	449
Prometheus	
Promodem 2400B Internal	98
Promodem 2400G External	149
USRobotics	
2400 Sportster Int/Ext.	119/147
2400 Sportster Int/Ext	159 199
Courier HST 14,400 /Int Ext	539/579
Courier HST 14,400 Dual Standard Ext	859
Video 7	
VGA 1024i 256K	179
VGA 1024i 512K	209
V-RAM VGA 512K	299
ZOOM	
HC2400 Internal	79
2400 V 42bis External Modem	169
9624 Send/Receive Internal Fax Modem	129

MONITORS

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Diamond Scan 1381	479
NEC	
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Multisync GS 2a	199
Multisync 3d	629
Multisync 4d	Call
Panasonic C1381 VGA	439
Princeton	Call
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The FastData 16bit VGA card features 256K of video memory, does CGA, EGA, & VGA up to 1024x768 and comes with drivers for popular software including Windows 3.0. It's expandable to 512K and has a 30 day money-back guarantee. **$89** **$119**

FastData 16bit 1mb VGA	159
FastData CGA Card	35
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FastData 2400 Baud Internal Modem

$69 The FastData 2400 baud internal modem is fully Hayes compatible and can be configured to COM port 1-4. It has an internal speaker, is auto answer & auto dial, and comes with BitCom software.

9600B SendFax w/ 2400B Modem	99
MFM 16 Bit 1:1 Hard/Floppy Disk Cont	59
Parallel/Dual Serial/Game Card	29
RLL 16bit 1:1 Hard/Floppy Disk Cont	69
XT 1.44 Dual Floppy Controller	35

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Your best value, we have a complete line made for us by leading manufacturers like Samsung & Hyundai. Like all FastData products, you have a full 30 day money back guarantee. Shown is the VGA Color for $279.

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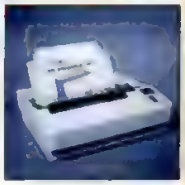
12" Amber Monochrome	79
14" Amber Monochrome	109
14" White Monochrome	109
14" White VGA Monochrome	129
14" CGA Color 52 dot pitch	199
14" VGA Color 39 dot pitch	269
14" VGA Color 31 dot pitch	319
14" Super VGA 1024 x 768i .28 dp	349

PRINTERS

Canon BJ10E	319
BJ300/BJ330	495/Call

Citizen GSX140 $285



Loaded with features, this 24 pin printer is a hot seller! It comes with 6 resident fonts, paper parking, and Epson & IBM printing modes. It does up to 192 CPS and has a unique LCD control panel that lets you set everything without DIP switches. Upgrade to color anytime for just $39.

Citizen	
200GX	189
GSX140 / GSX145	285/395
Fujitsu DL3400	359
NEC	
P3200	269
P3300	369
P6200	469
P6300	629
OKIDATA Okilaser 400	669

NEC Silentwriter 2 Model 90 $1595

PC Magazine's editor's choice! The new NEC model 90 comes with 2mb of memory, Postscript by Adobe with 35 fonts and parallel, serial and Appletalk interfaces. All this and 6 ppm speed, an easy-to-use LCD operator panel and letter, legal, & envelope feed.

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KXP1624	429
KXP4420 Laser	829
KXP4450/4455 Lasers	Call
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NX1001	149
NX1500	299
NX2410	249
XB2410 / 2415	429 . 569
Texas Instruments Microlaser PS17	1199
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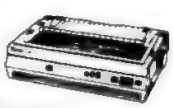

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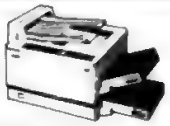

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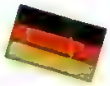

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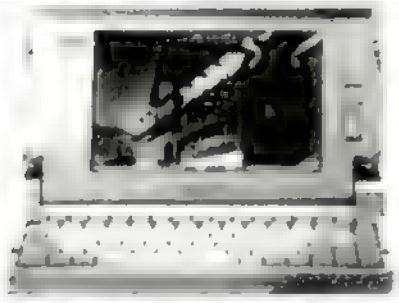

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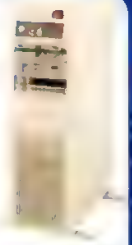

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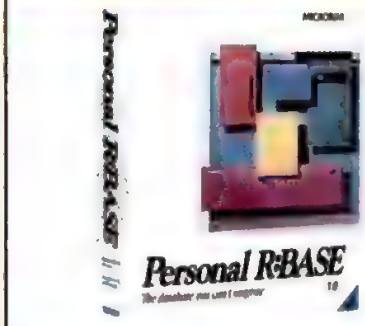

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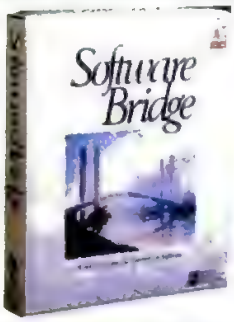

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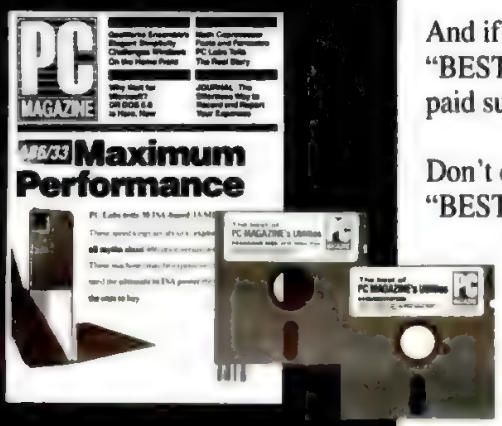

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by
Joe Salemi

Advisor

Help for Readers Making Personal Computer Decisions

- SPEEDING AN XT'S KEYBOARD: Is there a way to speed up the keyboard on an XT?
- TRACKING STOCKS: What programs exist that provide real-time stock market tracking and analysis?
- CONNECTING TO A DEC VAX WHILE RUNNING WINDOWS 3.0: Four Windows programs that emulate a VT220 terminal.
- FILE-TRANSFER PROGRAMS THAT DO DIRECTORIES: Transferring data through a direct connection between two PCs.
- CURING INTERMITTENT HARD DISK FAILURES: Why a hard disk may fail only after the PC has been running for a while.

SPEEDING AN XT'S KEYBOARD

I use a tiny 15K program called FASTKB.COM to speed up the keyboard on my AT.

Is there a similar program available for my XT? The slow XT keyboard is driving me nuts.

Felix Huber
Osaka, Japan

You're in luck; *PC Magazine* contributing editor Michael J. Mefford wrote just such a utility for our April 24, 1990, issue. TYPEFAST.COM works on any PC, XT, AT, or PS/2, and only occupies 300 bytes of RAM, so you may want to use it on both of your machines. You can download TYPEFAST.COM from PC MagNet's Utilities/Tips forum, Library 2 (Enter GO UTILITIES from any MagNet prompt). Instructions for joining PC MagNet are printed on page 8 of this issue.

TRACKING STOCKS

I am interested in using my PC to research, select, and track stocks.

One product I saw reviewed in the October 17, 1989, issue of *PC Magazine* was a product called *Live Wire*. This product, when cabled in from FNN, can recognize stock symbols as the ticker data moves across the screen, and keep a history of the quotes. It can also create graphs and other statistics.

I tried to contact the company at the 800 number listed in the article, but the phone company recording stated that the number was no longer in service. Several direct calls to the office in Fairfield, Iowa, went unanswered.

Can you find out if this company is still in business? If not, do you know of any other product like this?

Dan Bunnell
Walnut, California

I had no more success than you did in tracking down the company that made *Live Wire*. However, I did find two other products that may fit the bill for you.

The first is *Signal* (Lotus Development Corp., Cambridge, Mass.; 617-577-1299; $595); this product uses a system where it receives real-time stock market info via a special radio channel. It imports the data directly into *Lotus 1-2-3* or *Symphony* for analysis and graphing. The monthly cost for accessing the central computers varies with the amount of data you receive, and the number of stocks you track.

The other product is *Quotron Open Windows* (Quotron Systems, Los Angeles, Calif.; 800-877-4600, 213-827-4600; $500 installation fee plus monthly fees).

Quotron is the company that makes the custom terminals used by most stock brokers and investors to track the stock market. It also provides extensive market reports, and maintains a central database of historical securities and market data.

Quotron Open Windows is actually a collection of three modules; QuoTerm is the module that provides the emulation of a Quotron terminal and handles the connections to the Quotron network. It costs $100 per month.

QuotData is the module that handles the storage and manipulation of the data on your system. It also collects and stores the real-time data from the Quotron network on your machine, and carries a $250 per month fee.

The final module is QuotChart; this piece can create charts and graphs for analyzing the data stored by QuotData, and costs $300 per month.

Determining which program is right for your needs mostly depends on how big your portfolio is. If you only have a few stocks that you want to track, you'd be better off with *Signal*.

However, if your portfolio is extensive, or you have a need to access historical data or other services provided by Quotron, *Quotron Open Windows* would be the only way to go.

Investors whose portfolios require less frequent tracking may be satisfied with the portfolio management tools in *Andrew Tobias's Managing Your Money* from Meca Software or *Quicken* 4.0 from Intuit. These two will total up your holdings, after you've entered the number of shares and the price. They're not adequate to manage heavy trading or to analyze stock trends. They're for the investor who buys stocks only occasionally and holds them for the long-term.

CONNECTING TO A DEC VAX WHILE RUNNING WINDOWS

I read the feature review of 3270 terminal emulators in the February 26, 1991, issue but am looking for something that the article did not mention.

Can you suggest similar products for VAX (VT220/320) terminal emulators that run under *Windows* 3.0?

John E. Roling
Marion, Iowa

Most DOS communications programs support some form of VT terminal emulation, as VAX communications are usually done via the serial port. The most common emulation is VT102, but I know two products that specifically support VT220.

EM320 (Diversified Computer Systems Inc., Boulder, Colo.; 303-447-9251; $189) and *Relay Gold* (Microcom Inc., Norwood, Mass.; 800-822-8224, 617-551-1000; $299). Both products work fine in DOS windows under *Windows* 3.0.

There are two true *Windows* communications programs that support VT terminal emulation. *Crosstalk for Windows* (DCA Inc, Roswell, Ga.; 404-998-3998; $195) supports VT102 emulations. The product that most fits your needs, though, is

Dynacomm (Future Soft, Houston, Tex.; 713-496-9400; $295); it includes VT220 among it terminal emulations. Both also support other *Windows* features, such as the Clipboard and DDE.

FILE-TRANSFER PROGRAMS THAT DO DIRECTORIES

I am looking for a utility that allows direct hard-disk-to-hard-disk file transfers between two PCs, including directories and its subdirectories.

I cannot use the *PC Magazine* utility *ZCOPY* because of its inability to automatically transfer subdirectories. Any suggestions?

Deepak Thakkar
Cliffside Park, New Jersey

There are a couple of commercial packages that do what you need; the most popular ones are *LapLink III* (Traveling Software Inc., Bothell, Wash.; 800-662-2652, 206-483-8088; $150) and *Brooklyn Bridge* (Fifth Generation Systems Inc., Baton Rouge, La.; 800-873-4384, 504-291-7221; $139.95).

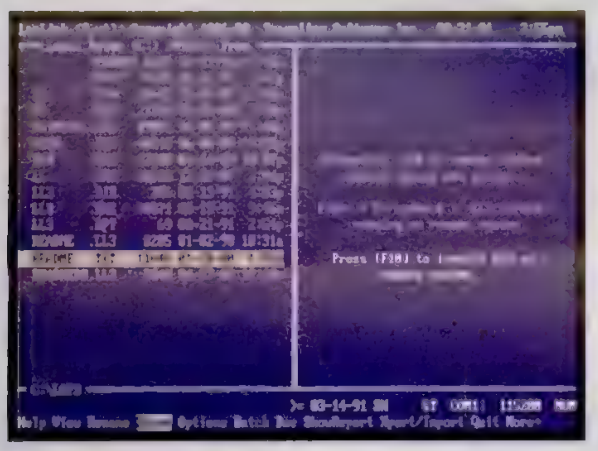
These packages were originally developed to ease the transfer of data between a desktop PC and a portable or laptop PC, via the serial ports. Over the years they have been improved to increase the transfer speed, and to support parallel port connections as well.

They also have the ability to access the other computers' drives as if they were attached to your PC, and can be used like a simple LAN connection between two desktop computers.

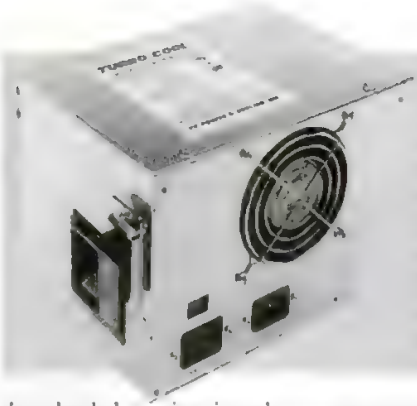
For example, *LapLink III* will generate a directory tree of your hard disk structure, to help you better manage transfers of entire subdirectories.

One of the best new features in *LapLink III* is a "remote download"—the ability to connect with a system that does not have *LapLink* installed (see Figure 1).

Traditionally, file-transfer programs required two separate versions of the product, one at each end. When the initial connection was made, the programs search each other to make sure that each program has a unique serial number. If you tried to use a copy of the same version to make the connection, the programs would refuse to make the link. *LapLink III* helps you get around that, although you may still want two copies since the downloaded version is only a subset of the main program.



When you attempt to connect *LapLink III* with another computer that's not running *LapLink*, you have the option of installing a limited version. In this screen, the left side represents the host computer; on the right side, *LapLink* offers the option of transferring code that will enable the remote machine to receive files. For the transfer to work, the receiving PC must have its port configured with DOS MODE and CTTY commands.



An inadequate power supply can cause intermittent hardware failures; when the power supply works at maximum capacity, it generates excess heat.

CURING INTERMITTENT HARD DISK FAILURES

My 20-MHz 386 PC with a 130MB hard disk operates fine at start-up, but after 45 to 60 minutes I begin to get system errors or "can't read" errors, particularly when attempting to print.

If I turn off the system, allow it to sit and then restart, the same cycle is repeated.

I have already tried a low-level format and reformatted the disk, but the problem persists. Any suggestions?

Steven Biggs
Wendell, North Carolina

The most common cause of failures after a system is running for a while is heat buildup. As the components of the system get warmer, any chips or circuits that are particularly sensitive to heat either start working intermittently, or fail completely.

The fact that the problem disappears after you let your system cool down suggests that this is the cause.

The most common cause of heat buildup is inadequate air circulation in the machine. First, check to see if there is any dust buildup inside the machine, especially around the fan vents, which may be interfering with the system's ability to dissipate heat. If you find that there is, use a small vacuum cleaner to clear it out.

Also, make sure the machine's air vents aren't being blocked because the computer is too close to the wall, or is surrounded by things that can block the air flow, such as books, or an overly restrictive compartment in your desk.

Finally, it's possible that the power supply isn't adequate for the number of cards you have in your machine, and is working harder than it should, generating too much heat in the process.

Most 386 machines come with a 200-watt power supply, which is usually more than sufficient. However, if you have a lot of cards in the machine or cards that tend to run warm (such as a 3270 emulation adapter), you should upgrade the power supply to one of higher wattage with better cooling abilities.

PC Power & Cooling (Bonsall, Calif.; 619-723-9513) has an extensive line of power supplies that increase the wattage and improve ventilation.

The TurboCool 300 sells for $189 and it works on most PCs; when you order, you'll need to specify whether your machine is a desktop or tower configuration (see Figure 2). TurboCool 275 is for slimline and pizza-box-size machines.

If the cooling and power check out fine and the disk failures persist, then your problem is that one of the disk subsystem components is failing when it gets too warm. The tricky part is determining which one it is. The most likely suspect is the hard disk controller; swapping it out for a different one would be the easiest test.

If changing controllers doesn't solve the problem, it's possible that the bad chip is on the motherboard, in which case you'll have to get the system serviced.

ASK THE ADVISOR

Send your questions to PC Advisor, One Park Avenue, New York, NY 10016, or upload them to PC MagNet (see the instructions for joining on page 8 of this issue). Sorry, but we cannot send personal replies. ■

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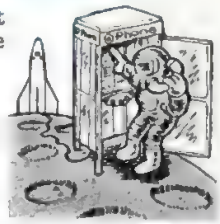

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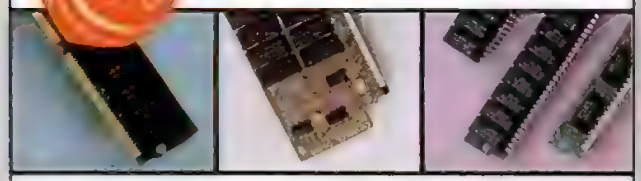

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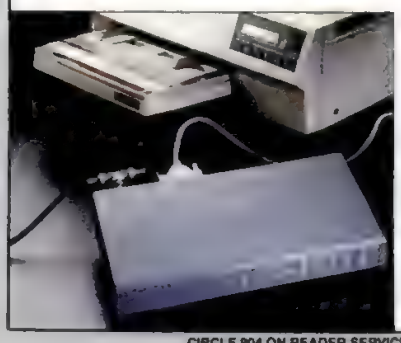

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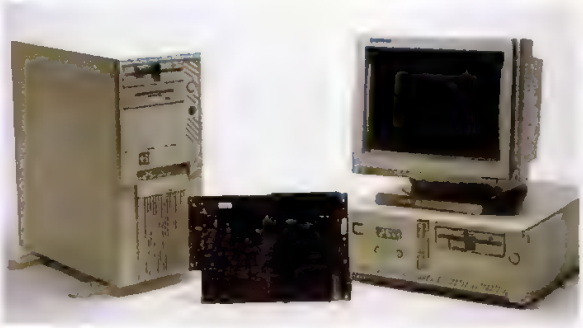

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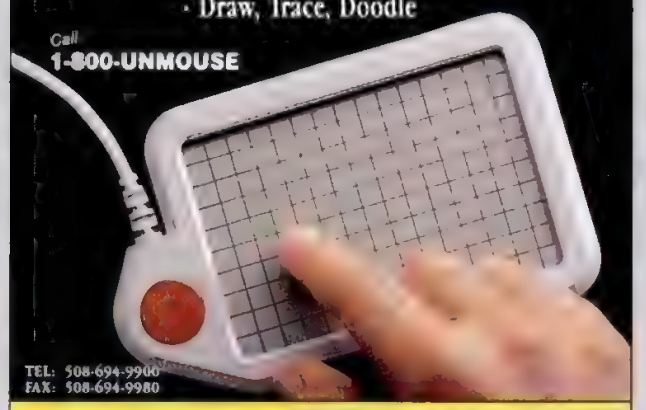

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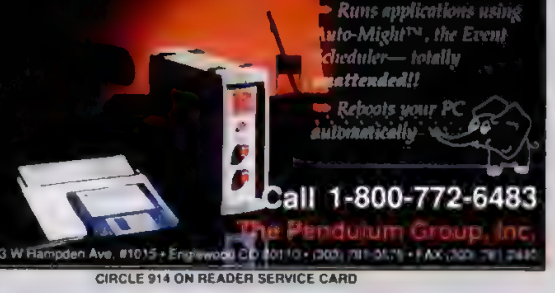

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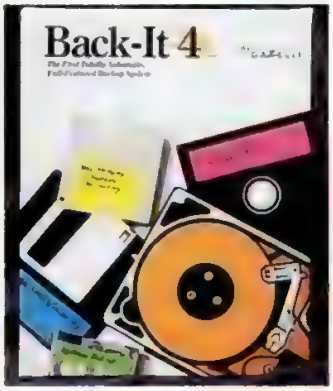

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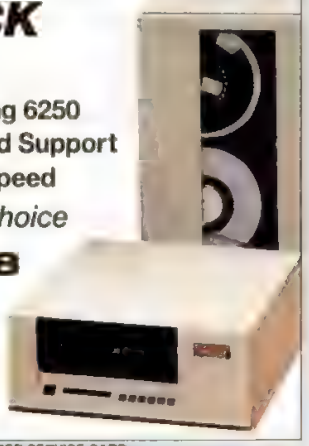

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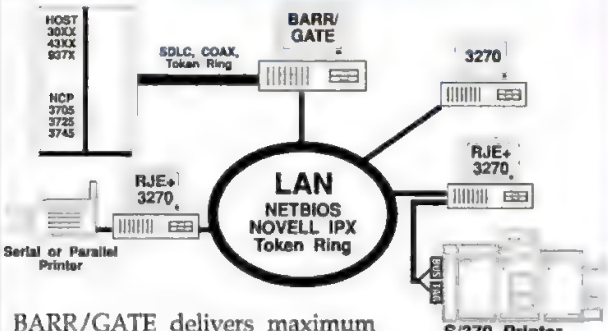

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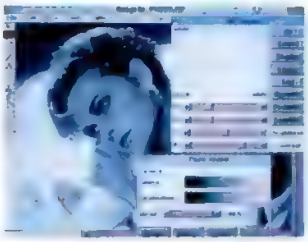

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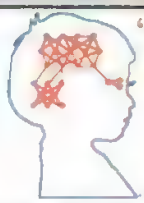

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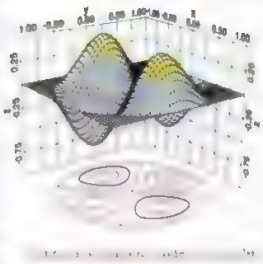

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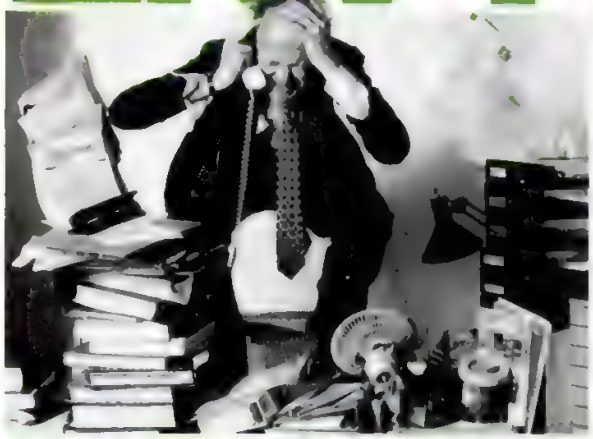

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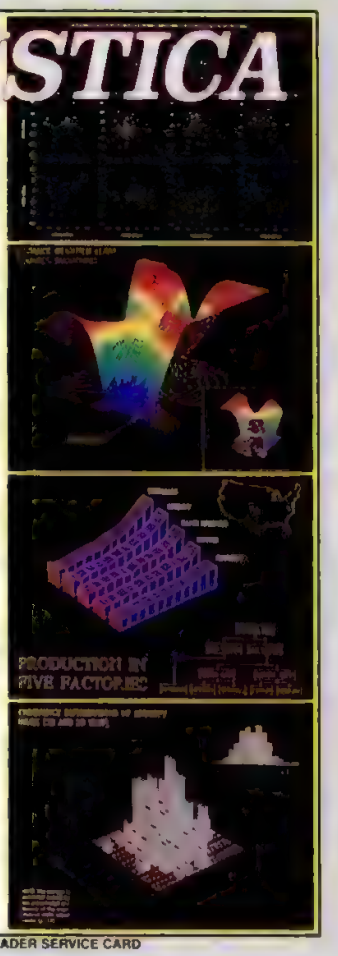

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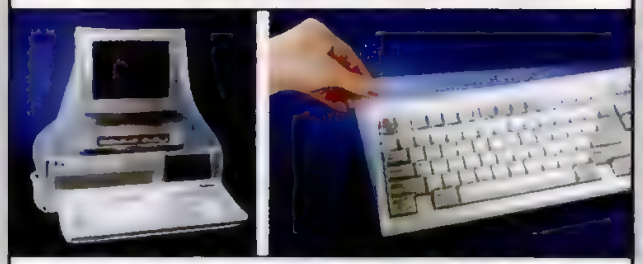

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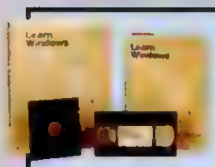

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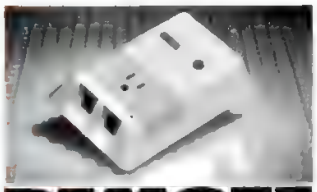

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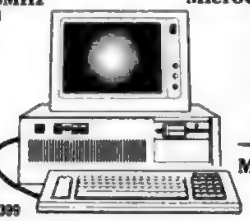

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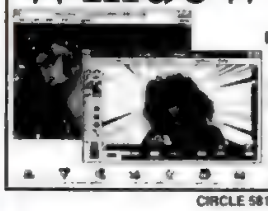

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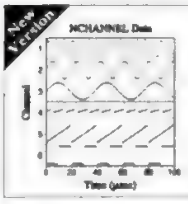

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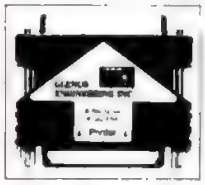

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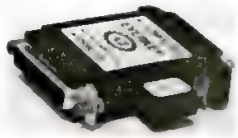

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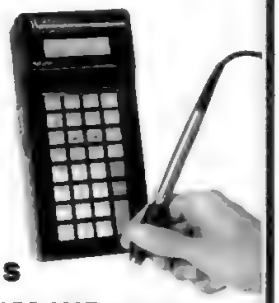

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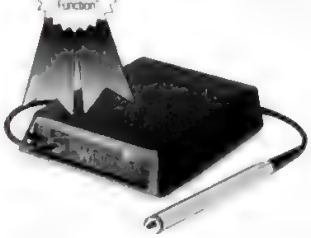

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Source: Beta Research Study, 1988
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PC Magazine is published 22 times a year, (bimonthly except for July and August). The BusinessCard closing is approximately two months prior to issue date.
Please send copy and payment to: PC Magazine BusinessCard, One Park Avenue, 3rd Floor, New York, NY 10016, ATT'N: Vickie Pinsky. *For more information, call Vickie Pinsky at* **800-825-4237** *or* **212-503-5120, FAX: 212-503-5860.**

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8. What are the benefits of upgrading to the new version of a software product I use?
9. How do I reach a manufacturer? Is there an 800 number?
10. What are the marketing strategies of a given computer industry company...who is the key marketing contact?

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COMING UP

■ HAND-HELD ORGANIZERS

Less than laptops but so much more than calculators, the best hand-held organizers let you schedule meetings, track personal finances, look up (and even dial) phone numbers, and connect to your PC with ease. In this comparative roundup, we review the Sharp Wizard, Casio B.O.S.S., Atari Portfolio, Psion Organiser II, and Poqet PC.

■ THE BEST WORDPERFECT BOOKS

You don't have time to read 34 books about *WordPerfect*, so we've done it for you. Find out which books are the best in seven categories including pocket references, complete guides, and quick-start tutorials.

■ REMOTE-CONTROL SOFTWARE

Supervisors, software trainers, and troubleshooters alike can take advantage of the capabilities of remote-control software. The 13 packages we review here allow you to monitor and control the screens of the users on your LAN, which means that you no longer have to leave your desk in order to help them solve problems, understand software concepts, and accomplish tasks.

■ MAPPING SOFTWARE

If you're interested in analyzing and presenting geographically based data, check out these three general-purpose mapping programs, all for $3,000 or less. From sales to marketing, your business can look at numbers in a whole new way.

■ 13- TO 15-INCH SVGA MONITORS

Although monitors are moving to the 16- to 17-inch form factor, 13- to 15-inch monitors still offer the most mainstream solution for today's business applications. *PC Magazine* takes a look at 25 Super VGA monitors most representative of today's marketplace. Also, we'll explore technological trends, and investigate pressing ergonomic issues. ■

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After Hours

Products for the Leisure Side of Personal Computing

National Geographic and IBM Team Up to Capture Mammals on CD-ROM

EDUCATION
by Don Trivette

I can name all the presidents and most of the state capitals, and I at least recognize the names of foreign countries, so it came as a shock to learn how little I really know about the animal kingdom. The eye-opener was National Geographic's *Mammals: A Multimedia Encyclopedia*. Distributed on CD-ROM, *Mammals* was codeveloped with IBM, and covers more than 200 different animals in words, pictures, sound, and—best of all—video.

Aside from the overall excellence of the package, the video is easily the most exciting feature of *Mammals*. It's almost like watching an encyclopedia come to breathtaking, full-color life. You see the animals in their natural habitats, and learn more from a few seconds of video than you would from reams of print. After all, only a moving picture can convey the power and beauty of a cheetah as it streaks at full speed toward its prey.

While the video doesn't have a high enough frame rate to be considered true full-motion video, the moving images are smooth, detailed, and exciting. Technically, the minimally acceptable frame rate for full-motion video is about 24 frames per second (television images are displayed at 30 frames per second); the video in *Mammals* operates at 15 frames per second. But that's fast enough to effectively translate award-winning National Geographic film sequences to your VGA screen.

Since the package was produced with IBM's *LinkWay* hypermedia authoring system, individual images, motion sequences, and text can be pulled out for use in student reports and other projects. National Geographic has given permission for the material included in *Mammals* to be reproduced for noncommercial purposes.

Mammals is divided into six interrelated parts. A new user can review the tutorial "Getting Started" to learn how to get the most from *Mammals*, but the product is so intuitive that I expect most users will do as I did

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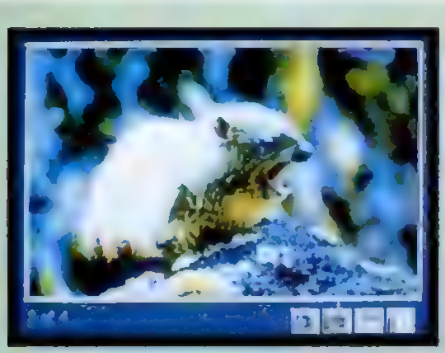
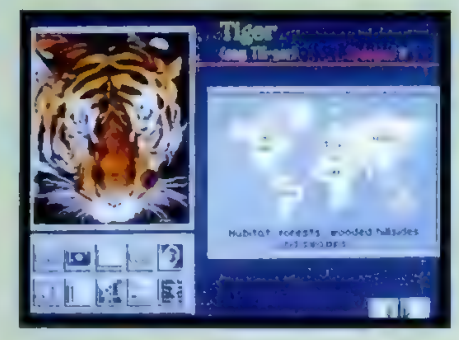
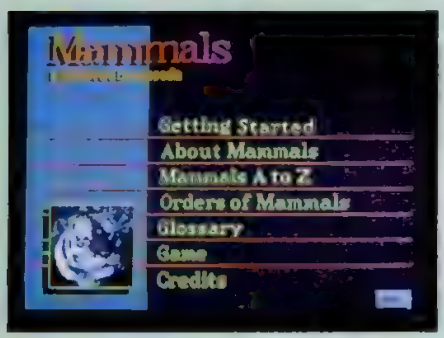


The tiny hyrax is one of the creatures you will encounter in *Mammals*. Its closest relative is the elephant.



By clicking on a map icon, you can display a natural habitat map of any of the animals included in *Mammals*.



Mammals: A Multimedia Encyclopedia has a simple, inviting main menu that offers several search methods.

EDUCATION
Mammals: A Multimedia Encyclopedia gives you a reason to buy a CD-ROM player.

GAMES
Win friends and influence aliens in *Lightspeed*.

Freakin' Funky Fuzzballs pits you against a marauding vacuum cleaner

Commander Keen: Nintendo-like action with smoothly scrolling graphics

Mammals

CONTINUED

and plunge right in. "Mammals A to Z" and "Orders of Mammals" are the two indexes used to locate information about individual animals. Also available from the main menu are a general description of mammals, a glossary, and a deductive game wherein you must identify an animal from its characteristics.

Aardwolf? Coati? Tucotuco? As an old fan of "Wild Kingdom" and "The Tonight Show," I wonder how there can be so many critters I've never even heard of. There's the pangolin, a mammal that looks like a walking pine cone, the tiny hyrax, whose closest relative is the elephant, and a spiral-horned antelope called a kudu. I spent hours reading about, watching, and listening to these creatures.

To go along with its sound, photographs, maps, and action video, *Mammals* has a mouse-based icon interface second to none. Click on the ear icon and you'll hear a roar, squeak, grunt, or other sound appropriate to the animal; click on the map and you'll see its range; click on the movie screen and you'll get a motion picture clip of the animal in action. There are more than 200 different mammals, 700 color photographs, 600 pages of text, 155 animal vocalizations, and 45 video clips.

The more scholarly user may want to peruse mammals by their zoological order. Although names like Artiodactyl, Dermopteran, and Tubulidentates twist my tongue, I can hear them pronounced simply by clicking on the word.

The only drawback to *Mammals*—indeed, to all multimedia products—is the souped-up hardware required to pull it off. The data transfer rate of the CD-ROM drive is absolutely critical; older players may not be fast enough to do justice to the motion sequences. And because the left and right sound tracks contain different audio, you'll need a CD-ROM player that's capable of discretely playing either channel.

Mammals is a trendsetter that showcases what can be done with multimedia; it's sure to become a standard reference work in both home and school CD-ROM libraries. Applications like this will stimulate interest in the CD-ROM format, especially in school settings where shared machines lower the cost per user. And make no mistake about it; there is no medium other than CD-ROM that would efficiently deliver an application as stunning as *Mammals*.

List Price: *Mammals: A Multimedia Encyclopedia*, $149.95 ($99 to educational institutions). **Requires:** 640K RAM, VGA monitor, mouse, DOS 3.3 or later, CD-ROM with Microsoft CD-ROM extensions, Version 2.1, and audio capability. National Geographic Society Educational Services, Dept. 5397, Washington, DC 20036; 800-368-2728, 301-921-1330 (in Maryland).

CIRCLE 608 ON READER SERVICE CARD

Lightspeed Adds Trade And Negotiation to Outer Space Shoot-'em-up

GAMES
by Barry Brenesal

Imagine a time when the human race abandons earth and travels to an alien star cluster to search for new planets. As the rest of humanity slumbers in suspended animation, you take out a scout ship to begin the difficult quest for a new home.

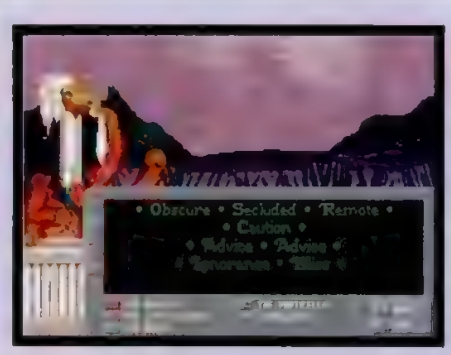
That's the easy part. The hard part comes when you discover numerous alien species in a bewildering web of alliances, betrayals, and piracy. Who can you trade with? Who can you trust? Time is expiring for your would-be colonists, and you've got to find them a suitable world in a relatively safe universe.

Don't let grim words such as piracy and betrayal give you the wrong idea about Microprose's *Lightspeed*. This new role-playing adventure doesn't go all out for humor, like Electronic Arts' *Starflight* series or Sierra's loony *Space Quest* saga, but its universe is still a long way from the usual xenophobic nightmare of typical arcade games.

Lightspeed's alien races run the gamut; they may be threatening, friendly, or questionable. Encountering them is often bizarre and always fun. That's because *Lightspeed* adds a third dimension to *Wing Commander*'s (After Hours, March 26, 1991) battle tactics and *Star Control*'s (After Hours, November 27, 1990) strategies of production and dominance: interaction. You don't just fight and build. You also talk and trade. Destruction may lie ahead, but every race you meet will first seek an ally, request information, or propose a mutual enemy for you to attack.

These alien beings should be encountered, as their rich, individual civilizations deserve, on a good VGA monitor. That's the only place where you can truly appreciate bewigged, handkerchief-wielding camels, dressed like 18th-century French aristocrats. Or a multifanged warrior race that lives for vengeance and snacks on teddy bear heads between meals. Appropriately chosen music and GUI-like dialog boxes with individually tailored fonts reinforce the sense of something new and different at each confrontation.

Conversation with the extraterrestrials is important, because trade is a must in *Lightspeed*. You have to upgrade your spaceship, or confront your foes with inferior armaments. Some alien races place high value on a particular engineering commodity. If you have the product, you go to a star system where it's in demand. You also need a second line of products, "planetary resources," which no self-respecting new colony can do without. Here, as elsewhere, the merchants' ancient "buy cheap, sell dear" code is honored. Ignore it at your own economic peril.



The beings you meet while playing *Lightspeed* are hardly your garden-variety aliens. To survive, you must form alliances.

That brings us to tactical combat, which is another difficulty you must face. Each species fields its own ships, and your opponents vary greatly in capability and tactics. The bat-like Dacians deploy multiple small, pentagonal ships with considerable firepower. A time-traveling creature sends one mediocre vessel after another, as it replicates itself in the past.

Conflicts vary greatly, and are less a matter of quick reflexes than choosing the right combination of weaponry and movement. With few exceptions, experienced arcade dwellers are likely to consider *Lightspeed*'s alien opponents small potatoes. Still, for us number/word/data-crunchers, the game provides plenty of challenge without the ignominy of constant defeat. (And if you lose, you don't die, you just lose a few points and get a fresh ship.)

The star map, trade and battle interfaces are very easy to master, and the game runs quickly on a 286 or 386; too quickly, in fact. If there's one criticism that can be leveled at *Lightspeed*, it's the short length of time required to master its two scenarios: a

CONTINUES

Lightspeed

CONTINUED

week at the most. You can try for a better score or battle average after winning, but the placement of objects and worlds remains the same. Still, it's a pretty successful game if the only criticism amounts to regret when you're finished.

Lightspeed features clever dialogue, excellent graphics, animation and music, and a large collection of fascinating aliens. It's a delightfully entertaining mixture of adventure, strategy and tactics. But the best news may be that Microprose has already promised to release a sequel before year's end.

List Price: *Lightspeed*, $59.95. **Requires:** 512K RAM (640K for VGA/MCGA), DOS 2.1 or later, CGA, EGA, VGA, or MCGA graphics. 286 or better recommended. Microprose Software, 180 Lakefront Dr., Hunt Valley, MD 21030; 301-771-1151.

CIRCLE 609 ON READER SERVICE CARD

Get a Taste of Life At Carpet Level with Freakin' Funky Fuzzballs

GAMES by Clayte C. Brownlee

Imagine you're a dust bunny (or fuzzball) being endlessly pursued by a vacuum cleaner. There's no escape; the best you can hope for is survival. This is the basis of *Freakin' Funky Fuzzballs*, an arcade game that's long on action but somewhat short on plot.

But then playability—not narrative flow—has always been the strong suit of arcade games, and this is where *Freakin' Funky Fuzzballs* excels. The game may seem innocuous, but beware: It's more addictive than Godiva chocolates. And at only $29.95, it costs less than some Godiva assortments, too.

The story line is kept to a minimum; all you're told is that you're a fuzzball being chased by an enemy. I'm guessing that the enemy is a vacuum cleaner, a tank model by the look of things. After all, what else would chase a fuzzball? But make no mistake, you are no ordinary dust bunny. You're a dust bunny that eats, runs, and uses a key to unlock doors.

The object of the game is to stay alive. Fuzzballs are a lot like sharks—if they stop moving, they die. If they get chomped too many times by the ever-present vacuum cleaner, they suffer the same fate. And if they're not careful, they roll into a corner from which there's no escape.

Old-time gamers may be struck by a few amusing similarities to *Rogue*, one of the earliest computer maze games. To survive, you move your fuzzball through a series of mazes while picking up the keys that unlock the next level. Along the way, you build up vitality (or fuzz power) and strength by grabbing rings and food. Admirably, foods like turkey and apples boost your strength more than fries and shakes. That's a big improvement over *Rogue*, which rewarded you for eating with comments like "My, that was a yummy mango." There are also magic goodies to be uncovered, including wands for passing over vacant squares, scrolls for casting spells (most of which only confuse the poor fuzzball), and shields and armor for limited protection against the enemy.

In all, there are fifteen levels divided into five worlds, each with its own type of action. In World Three (Modern Day), the movement suddenly changes from straight to diagonal, and things get hairy. By World Five (the final level), you're playing in darkness.

In addition to the many levels, there are two modes of play and two levels of difficulty (beginner and expert). One mode lets one to ten players compete for the highest score and the highest level, while the other lets two players compete head-to-head as fuzzball and vacuum cleaner. I can't imagine how tough the expert level must be; I've barely made it to level 9 playing as a beginner.

Though you can hurl your fuzzball around on an EGA system, you'll find the graphics somewhat disappointing. Your best bet is to go with VGA, which gives you a 256-color view of your fuzzy alter-ego. Pay attention to the title sequence: With an optional AdLib sound card or a Roland MT32 installed, you get to hear the soundtrack that gives the game its funk. Regrettably, this is as good as the music gets. Besides the funk track that accompanies the opening titles, there's only one additional tune for all the playing fields, and it soon becomes redundant.

Fortunately, there's a "disable sound" option that comes in handy for those playing without a sound card. As tiresome as the music gets when generated by an AdLib card, it's nowhere near as annoying as the unenhanced sound effects from the PC's tiny built-in speaker.

I can't tell you how the game ends, since I'm still trying to master diagonal movement. I know it involves dynamite and revenge, and given a little more playing time, I'm sure I'll find out the specifics.

List Price: *Freakin' Funky Fuzzballs*, $29.95. **Requires:** 384K RAM for CGA graphics (CGA graphics supported on Tandy machines only); 512K RAM for EGA or 640K RAM for VGA graphics; DOS 2.0 or later. Sir Tech Software Inc., Ogdensburg Business Center, Ste. 2E, Ogdensburg, NY 13669; 315-393-6451.

CIRCLE 610 ON READER SERVICE CARD

Though it offers such new wrinkles as VGA graphics and sound card support, *Freakin' Funky Fuzzballs* is in the grand tradition of maze games started by *Rogue*.

Arcade Game Offers Nintendo-Style Action with Scrolling Graphics

GAMES by Barry Simon

Billy Blaze, an eight-year-old genius, made a space ship out of assorted junk around the house. One night while his parents were out and the baby-sitter was sleeping, Billy donned his brother's football helmet, became Commander Keen, and took off for Mars.

The evil Vorticons had established a base on the red planet in preparation for their conquest of the Earth. After Keen's arrival on the scene, they stole parts of his ship and hid them underground. That's the starting point

CONTINUES

Commander Keen

CONTINUED

for episode one of *Commander Keen: The Invasion of the Vorticons*. Obviously, you wouldn't purchase *Commander Keen* because of its scintillating plot or ground-breaking originality. It's an arcade game, pure and simple.

However, it's smooth scrolling graphics—with 16 colors at 320-by-200 resolution—set it apart. The graphics are redisplayed at a rate of 40 frames per second, which gives the game a "Nintendo" feel. The graphics aren't spectacular in and of themselves, but they are well drawn and the smooth scrolling makes up for the lower resolution.

Billy has to get through a number of underground cities—essentially mazes with obstacles to jump over and pitfalls to avoid. The object of the game is to find the four stolen ship parts, which are located near the city exits in four of the Martian cities. A joystick is the best choice for a game controller, although keyboard play is acceptable. Mice are not supported.

Some of the pitfalls are icy water, fiery furnaces and stationary, man-eating clams, all of which you can jump over. There are also robots that fire at you, as well as assorted monsters and the Vorticons themselves. The monsters, at least, can be stopped with your ray gun.

Besides episode one, subtitled "Marooned on Mars," there are two further episodes: "The Earth Explodes" and "Keen Must Die." Each introduces new twists. For example, you need to jump onto and ride moving platforms to get around some obstacles in episode two. All three scenarios are great fun.

The publisher, Apogee Software Productions, uses an interesting variation on the shareware distribution concept. Episode one is shareware, and is available for evaluation on PC MagNet's AfterHours forum. Episodes two and three can only be purchased from the publisher. ■

Though its graphics are rendered in low-resolution 320-by-200 mode, *Commander Keen* compensates with smoothly scrolling scenery.

List Price: *Commander Keen*, $15 per episode; all three episodes for $30. **Requires**: 520K free RAM, EGA or VGA graphics, DOS 2.0 or later. Apogee Software Productions, P.O. Box 476389, Garland, TX 75047; 800-852-5659.

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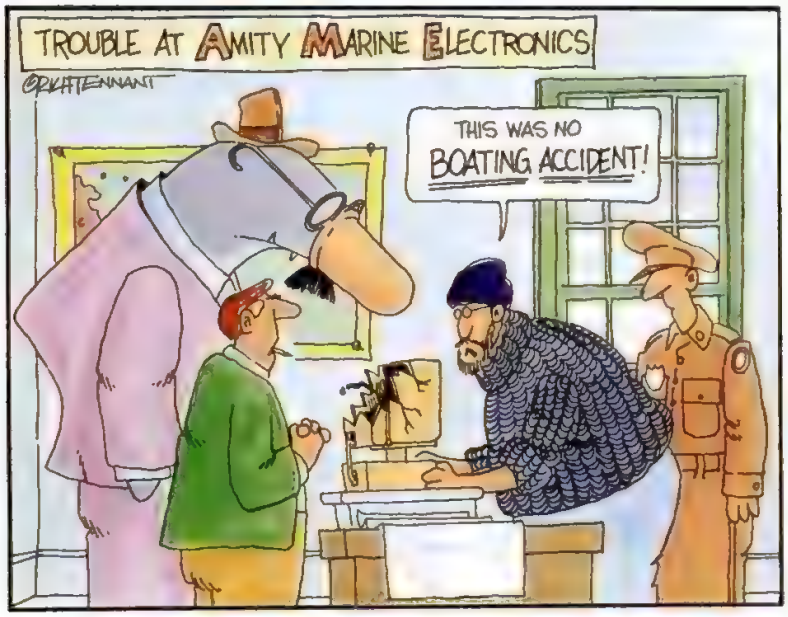
by Bill Howard

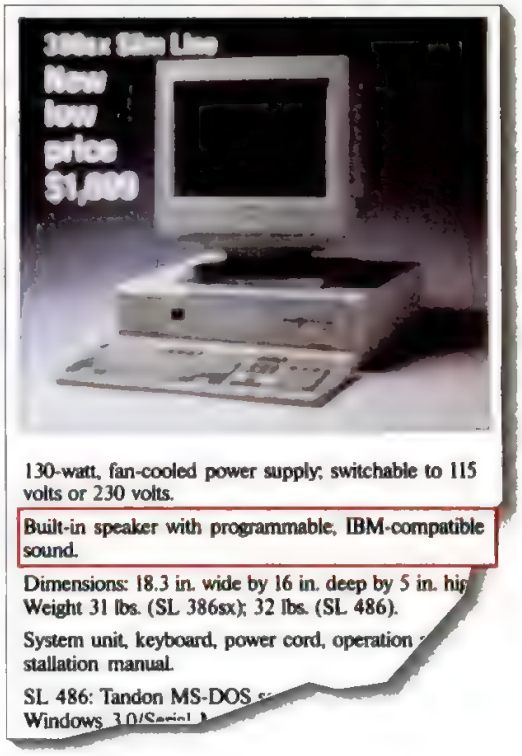
Abort, Retry, Fail?

The Lighter Side of Personal Computing



Teaching Secrets of the Ivy League

"Teacher In A Box gives you all the tools you need to learn a variety of PC software without ever opening the software manual. Using a proven training methodology called Reinforced Learning, based on studies at Harvard and Columbia Universities, Teacher In A Box cuts learning by 50%."
—Fall 1990 Tigersoft catalog



Something you never worried about (or wanted) before you saw this Tandon Computer Corp. ad: IBM-compatible sound.

Dictate-MCA Lets Users Create Documents By Typing

BY ED SCANNELL

Dragon Systems Inc. has followed the release of its first speech-recognition product ear-

As with the initial version, Dragon Dictate, the newly announced Dragon Dictate-MCA lets users create documents by speaking instead of typing. The

cording to the developer.

The program recognizes 30,000 words that are active simultaneously, and it has a 80,000-word

The story in *Infoworld* (November 26, 1990), describes a speech-recognition system that *replaces* typing.

Mea Culpa

"In this endurance test, the 386- and 386SX-based portable systems are put through their paces alongside such products as . . . a pocket LAN adapter for plugging into your company's network while you're at the Toledo Hilton."
—*PC Magazine*, December 25, 1990 (pocket LAN adapters require a direct connection to the LAN).

If your entry is used in Abort, Retry, Fail? we'll send you $50 and a *PC Magazine* T-shirt. Caution: In case of multiple entries, the postmark date, neatness and completeness of entry are considered. Winners this issue: Todd Glass (create documents by typing), Jon Angel (mea culpa), Jeff Garden (IBM-compatible sound), Brad Jones (cuts learning by 50%).

CARTOON: RICHARD TENNANT

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